THE AEROPLANE

Incorporating
Aeronautical Engineering
Edited by - - THURSTAN JAMES

Founder and First Editor
(1911-1939), C. G. GREY

Proprietors :
TEMPLE PRESS LIMITED
Chairman and
Managing Director :
ROLAND E. DANGERFIELD

Head Office :
BOWLING GREEN LANE,
LONDON, E.C.1.
Telephone : Terminus 3636
Telegrams :
"Pressimus London Telex"
Telex 23839

Vol. XCV. No. 2451 AUGUST 22, 1958

Annual Subscription Rate: U.K. £4.15.0.
Overseas £5. Canada and U.S.A. $15.00

TRADE IN TWO HEMISPHERES

JUST as we were going to press with this special issue of THE AEROPLANE, which contains our annual review of the Canadian Aircraft Industry, we received a little blue booklet from that great country. This booklet contains a verbatim report of the talk given by a leading member of the Canadian Aircraft Industry on his return from Russia. And it makes specially interesting reading.

As will readily be seen from a survey of the pages devoted to Canada in this issue, the industry has come a long way in the past few years. Its outstanding achievement has been the development of a remarkable long-range all-weather supersonic fighter and the large turbine engine to drive it. Another large military aircraft is the Canadair Argus; the Canadair CL-44 and 540 are coming along. A new transport, the D.H. Caribou, has recently made its first flight; it also has military backing.

Such developments mark considerable progress since Canada's infant industry began building the bush aircraft which did so much to open up the North-west. Now established in the production of military aircraft, fighters and transports, for the Royal Canadian Air Force, it must turn its eyes to World markets. A number of the types described in our pages are capable of development for this field.

It was from an aircraft industry with this background that Mr. Phil Garratt, the managing director of de Havilland Aircraft of Canada, Ltd., went off to visit Russia earlier this year. As he made clear in his talk, the party with which he travelled had no official backing. Twenty-nine of the party went as private citizens representing nobody and, as Mr. Garratt says, having no authority of any kind whatsoever.

Now the men in the party had varied interests and in consequence the tour covered a great deal that had nothing to do with aviation. Here we can only make reference to Mr. Garratt's aeronautical observations. They concern the general attitude of the Russians, some comments on the effectiveness of Western propaganda, notes on the Tu-104, notes on a factory building civil transports and an engine factory building turbines. They saw remarkably few aeroplanes in the air and no flying clubs.

Early in his talk Mr. Garratt made an interesting observation on technical information. The Russians have a central bureau, he thinks, that does nothing but study publications and newspapers and then directs the information to the various departments interested. As an illustration he recalls that while they were looking at turbine blades, the talk that day was about machine tools of one kind or another and Walter McLachlan was saying: "Well, we use this for this thing and that for that thing." His information, of course, was not definite, so their Russian hosts said: "Just a minute." They went to the library, pulled out a book and opened it up—and there were illustrations of all the machine tools made around the World in the particular categories under discussion.

An enlightening observation although nothing to do with aviation was that the geological survey of Russia was so far advanced that at the present rate of progress it would take Canada 100 years to get to the position the Russians are in today.

Another general observation, but of direct interest, was: "The point is, that whatever capacity the Russians have, it's 100% all the time, seven days a week. They achieve higher production by having fewer specifications for steel—half as many specifications and roughly half as many forms."

"We went and saw their shops," Mr. Garratt stated. "I asked the General twice how many Tu-104s they had in service and he just forgot to answer, but I reckoned from what they were doing that they must have at least 100 and probably more, because they're running this Tu-104 right to China—to Peking—they have sold them to the Czechs, and they have Czech Airlines running to Moscow with Tu-104s.

"They have the Il-18 that we'd seen in production at the Ilyushin factory. They had two or three of these at the Airport, and they were going through their development flying. They expect to put them on the airline carrying passengers by the end of August or September. We asked them, 'How much for one?' and they said, 'Well, we can't answer that, but we will get the answer for you from our Department of Foreign Trade.' Sure enough the next day they told us '$900,000.00'—so there's something that would make one think—a four-engined turbo-prop carrying 70-80 passengers for $900,000.00."

In this same issue of THE AEROPLANE we comment on the lifting of the embargo on strategic materials and the possible sale of aircraft material to the Communist and non-western world. Such opening of the commercial field is in accord with Mr. Garratt's views in his talk that he thought, as did his group, that we could do more towards peace by getting to know the Russians better and trading with them. It is equally clear from the figures that he gives that a tough commercial struggle is ahead.

MATTERS OF MOMENT

Ballistic-missile Detection

BRITAIN has developed a photocell device which will detect the infra-red radiation emitted by the launching of a ballistic missile up to 1,000 miles away. The device cannot be jammed. This news was given by Mr. Aubrey Jones, Minister of Supply, at Sydney on August 14.

British work on infra-red devices was described at the Royal Radar Establishment last April (THE AEROPLANE, May 2), when a homing head for a missile was shown to the Press. Indium antimonide cells were shown which responded to less than one-hundred millionth of a watt of radiant energy—equivalent to detecting at a range of a mile the heat from a soldering iron at 300° C. If a cell of this type is cooled by liquid oxygen its sensitivity is increased by 10 to 100 times.

Infra-red detection cells are used to guide the D.H. Firestreak air-to-air missile. They will probably also be used in the homing systems of anti-missile missiles, as discussed in THE AEROPLANE last week.

A Potential Export Market

WE learn that the British aircraft industry welcomes the statement by the Board of Trade that the embargo on the sale of aircraft and aero-engines in normal civil use to Soviet bloc countries and China has been relaxed.

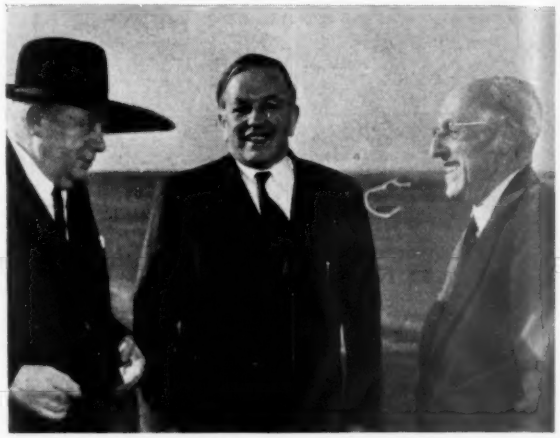
Therein lies a potential new market, but some caution must be expressed in view of the cheaper prices quoted for certain Russian aircraft and engines. A Tu-104 costs about £450,000; the Comet is priced at about £1¼ million, the Vanguard at about £900,000, and the Viscount at roughly half a million. For comparison, the French Caravelle sells at possibly £700,000. So exports of British commercial aircraft may not be affected.

The S.B.A.C. assures us that every effort will be made to develop these markets with a view to the possible expansion of our already increasing exports. The industry has for some time been studying possible markets in these countries, particularly China, although bearing in mind the relative costs noted above, it may be only with regard to agricultural aircraft and helicopters—and, of course, engines—that exports can be made.

The words "in normal civil use" in the Board of Trade's statement raise an interesting point concerning engines.

The Comet 4, due to be in service by the end of this year, is powered by Rolls-Royce Avon R.A.29 turbojets. There may well be a military version of this engine, which incorporates some of our latest techniques, such as air-cooled turbine blades. It is a more advanced design than the R.A.24 which powers the Hunter, Sea Vixen, Scimitar, Lightning and other types, and the prudence of releasing such an engine to the Soviet bloc and China must be regarded as questionable.

A similar situation is likely to arise over the Rolls-Royce Conway by-pass turbojet.



MINISTERIAL VISIT.—Sir Maurice Dean (centre), K.C.B., K.C.M.G., Permanent Under-Secretary of State for Air, visited the Avro factories at Chadderton and Woodford on August 15. Left, Sir Roy Dobson, managing director of the Hawker Siddeley Group, and Sir William Farren, technical director of A. V. Roe and Co., Ltd., on right.

U.S. Space Plans

AMERICA'S National Advisory Committee for Aeronautics —NACA—will form the nucleus of the newly formed National Aeronautics and Space Administration, or NASA. The new organization will also take over the facilities, personnel and activities of other U.S. agencies where these are working on non-military space studies and exploration. [THE AEROPLANE, August 1.]

An outline programme of NASA work has been prepared. Its suggestions come under four heads: unmanned space flights to gather scientific data; investigations of manned space flight; research and development on advanced components and techniques, and research facility requirements.

Unmanned space studies will include vertical firing of rockets, investigations of space environment by satellites, and the dispatch of lunar and interplanetary probe vehicles. Space flights are suggested for weather reconnaissance, development of communications systems and for astronomical investigations.

Manned space-flight development will be via small-scale recoverable satellites, vertical flight and re-entry vehicles and manned orbital and re-entry vehicles. This work will be supported by biological studies.

Research and development of components and techniques

LET LOOSE.—Untethered hovering trials of the Short SC.1 VTOL aircraft (five Rolls-Royce R.B. 108 turbojets) have begun at Belfast in a special test gantry. Here the SC.1 is hovering as evidenced by the slackness of the two lower cables. The upper is not taking any load and is a safety device.

will cover propulsion, space-vehicle systems, instrumentation and special test vehicles. Special rocket motors will be developed using conventional and high-energy propellents—a million-pound thrust motor is planned. Research facilities will be extended and new ones set up for work on high-energy rockets and guidance and control systems.

In a U.S. Congressional report on astronautics and space exploration it has been suggested that the NASA will need about £178 million a year for its first two or three years. In the present financial year some £123 million is available for its work.

U.S. Lunar Probe Fails

WHETHER Russia has made any attempts to send a rocket to the moon is not certainly known, but the first attempt by the U.S.A.F. to send a "lunar probe" rocket to the moon on August 17 was a failure. Launched from Cape Canaveral, the rocket broke up at about 50,000 ft., 77 sec. after take-off. It is particularly disappointing that failure occurred in the well-tried Thor first stage, which should have fired for an additional 80 sec.

Second stage was the liquid fuel Aerojet-General rocket for the Vanguard satellite, as modified for the Thor-Able vehicle used in recent nose-cone and mouse tests. The third stage was based on a solid-fuel rocket developed by the Allegheny Ballistics Laboratory. The terminal stage carried an 85-lb. payload of instruments, and had a small solid-fuel rocket for control near the surface of the moon.

Two more lunar-probe launchings are to be made by the U.S.A.F.; they are planned for September and October. Two will also be made by the U.S. Army; the first is scheduled for September.

Missile Nose Cones

THE blunt re-entry nose cones of ballistic missiles will in future probably give way to more pointed noses of "ablative" materials, according to U.S. reports. The nose cones which are now in production for the Thor, Atlas and Titan are blunt, heat-sink structures made from copper or copper-base alloys, but the Jupiter is to have an ablative nose cone.

Blunt nose cones are shaped to minimize aerodynamic surface heating when they enter the atmosphere at speeds up to 16,000 m.p.h. Surface heat is absorbed by their copper shells. Drawbacks of blunt-nosed entry cones are that they are heavy and have very high drag which makes them decelerate rapidly.

An increase in re-entry speed will be a feature of second-generation missiles; this will increase the difficulty of intercepting their warheads. The ablative nose cones now under development are sharp-nosed and made of materials which will melt, vaporize or sublime as they absorb heat. Typical materials for these are plastics, reinforced with glass fibres.

Double-decker Rocket Engine

LATEST powerplant announced by the de Havilland Engine Co., Ltd., is the Double Spectre D.Spe. D.1, which consists of a fixed-thrust Spectre D.Spe.4 mounted atop a variable-thrust Spectre D.Spe.5 (THE AEROPLANE, August 23, 1957, and February 7, 1958). The Double Spectre was recently put through an officially observed special-category type-test at Hatfield where a new test-bed has been built for it. Several hundred runs of the engine have been made, involving both single and double firings.

Although part of a new powerplant, the two Spectre units are little modified from the D.Spe.4 and 5 standards. They are carried on a tubular mounting at a small inclusive angle to one another, their thrust-lines intersecting on the centre of gravity of the installation.

The lower, variable-thrust rocket is started first. Nitrogen from a small storage bottle on the starboard side is used to supply hydrogen peroxide from the spherical starter bowl to the propellent-pump turbine. The peroxide then decomposes and drives the turbine up to such a speed that it is self-sufficient under the influence of the main pumped supply of propellent.

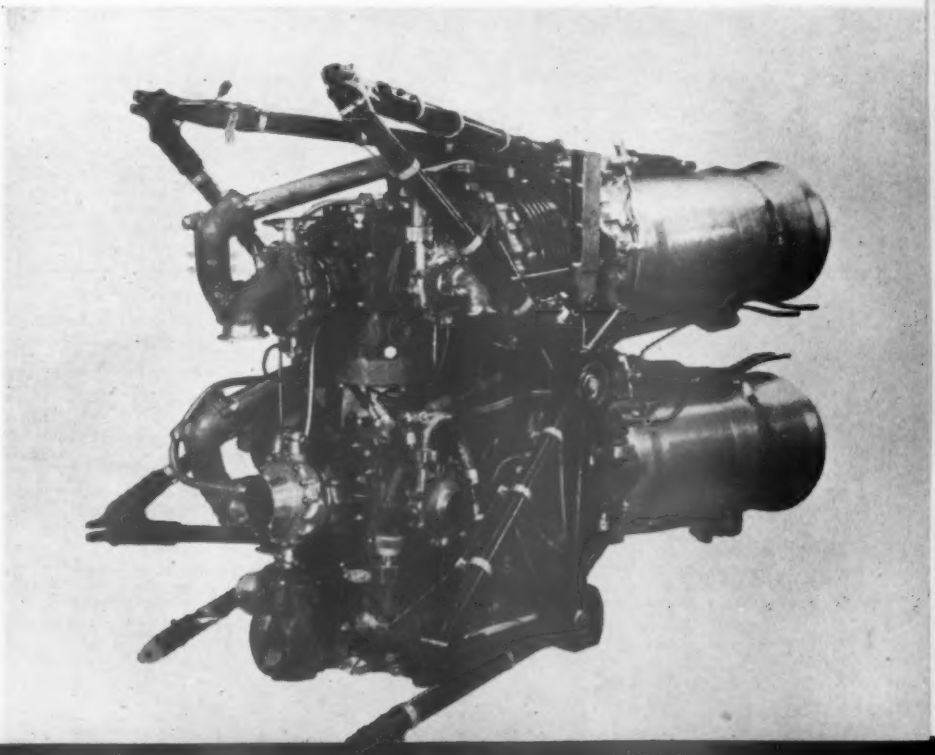
Peroxide oxidant is decomposed in the catalyst chamber by packs of silver-plated gauze, and kerosene fuel is injected into the hot gaseous products of decomposition so that thermal ignition takes place. Once the lower engine is firing a small bleed of peroxide can be fed across to energize the pump-turbine of the upper engine until this, too, becomes self-sustaining. This starting procedure takes a few seconds and thereafter a controlled variable thrust is available between the idling output of the lower engine and full thrust of both units.

Most likely application of the Double Spectre is in the Avro stand-off bomb, the first version of which is known to be rocket-powered (THE AEROPLANE, September 6, 1957), while later versions may have the D.H. Gyron Junior D.G.J.10 supersonic turbojet. The Double Spectre is 58.6 in. long and 37.5 in. high.

In this installation a possible procedure would be for the bomb to be launched and the lower Spectre fired. The second, fixed-thrust, Spectre could be started immediately after to accelerate the weapon to supersonic speed at a greater height than that of the subsonic V-bomber (about 50,000 ft.). The lower Spectre could be throttled back as weight reduced because of rapid consumption of propellent. Total thrust of the Double Spectre must be about 16,000 lb. because the Spectre is reckoned to have a thrust of about half this figure.

CONTENTS

ATTERS OF MOMENT 244
EWS ITEMS 246
TLANTIC COMET 248
IR TRANSPORT 250
ARACHUTING CHAMPIONSHIPS — John Fricker's Second Report 251
ANDLEY PAGE H.P.111 MILITARY TRANSPORT 252
PECIAL SUPPLEMENT — CANADIAN AVIATION TODAY
Post-War Air Transport in Canada, by Neil A. Macdougall 254
Aviation in Canada's Services 258
Canada's Aircraft Industry, by F. G. Swanborough 261
The Avro Arrow, Canadiar CL-41, CL-44 and 540, and D.H.C.4 Caribou 265
The Ancillary Industry 270
MPRESSIONS OF THE STRUCTURAL DESIGN OF CIVIL AIRCRAFT (Conclusion), by A. F. Newell 272
RIVATE FLYING 276
ORRESPONDENCE 277
REN'S WROUNDABOUT 277
OTES AND EVENTS 278



SPECTRAL TWIN.—Latest rocket engine by de Havillands is the Double Spectre D.Spe.D.1 of about 16,000 lb. thrust.

News of Aircraft, Engines and Missiles

Photograph copyright "The Aeroplane"

GERMAN LIGHTWEIGHT.—On August 15 an RW3 Multoplane, D-EFUP, built by the Rhein-Flugzeugbau G.m.b.H., arrived at Croydon. It is built in two forms, the RW3-A2 with a span of 50.7 ft., and the RW3-A3 of 34.2 ft. span. The former may be flown as a sailplane, but usually has a 65-b.h.p. Porsche 678/0 flat-four engine driving a two-blade pusher propeller under the tailplane. The 95-b.h.p. Continental is an alternative. A Turboméca Palas turbojet is being considered.

ARGOSY PROGRESS. — The first A.W.650 Argosy fuselage was transported from Baginton, Coventry, to the company's final assembly sheds at Bitteswell on August 10. The wing centre section with Dowty main undercarriage in position, the twin booms, and the four Rolls-Royce Dart turboprops are already at Bitteswell. Final assembly is expected to be completed by October. A second fuselage, fitted with strain gauges, is to be delivered to the Whitley works for testing in a new Braithwaite tank.

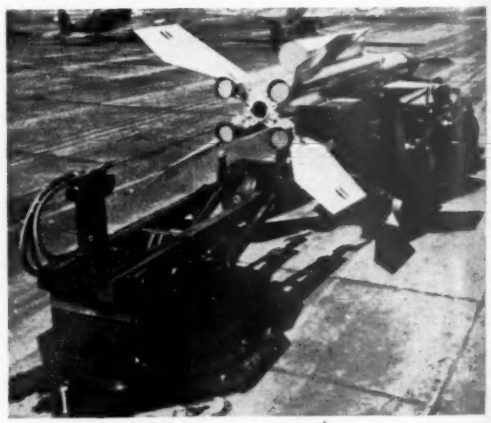
M.B. IN U.S.—On August 28 the Martin-Baker A.5 and G5 fully automatic ejection seats were successfully demonstrated in ground-level tests at the U.S. Naval Air Test Centre at Patuxent River. They are installed in the Grumman F9F-8T Cougar Trainer and the Chance Vought F8U-3 Crusader.

DART LIVES.—The Rolls-Royce Dart engines in B.E.A.'s Viscounts have now accumulated nearly 1,150,000 hours. The inter-overhaul lives of the Dart 506 and 510 have progressively increased to 1,800 hours—the highest figure ever approved by the A.R.B. Approval for 2,000 hours is expected in October. The Dart 520 (in the Viscount 806) now has an approved life of 600 hours—shortly, it is expected, to be increased to 800 hours.

FAIREY-KAMAN?—Negotiations are in progress for the possible building of the Fairey Rotodyne in the U.S. by the Kaman Aircraft Corpn. Fairey hopes that if they are completed military orders will be given by the U.S. Services.

PIAGGIO APPROVAL.—A U.S. type certificate has been awarded by the C.A.A. for the Italian Piaggio P.166 eight-seat executive aircraft. The second P.166, after flight testing at Villanova d'Albenga, will be sent to the U.S.A. for demonstration by the Trecker Aircraft Corpn.

BLOODHOUND ABROAD. —Seen here at a recent European air display the Bristol/Ferranti Bloodhound surface-to-air missile is in quantity production for the R.A.F. The picture shows the missile raised on its trolley and being reversed on to the launcher, which is depressed to receive it. The Bloodhound locates with the launcher rear support and is held in position by two arms under the forward boost fittings.



SKEETER 8.—Three Saunders-Roe Skeeter 8 helicopters are being built for C. of A. trials. The Skeeter 8 is the civil version of the military Skeeter 12.

JINDIVIK ORDER. — Britain is to order "not less than 50" Jindivik target aircraft from Australia, according to Mr. Aubrey Jones, the Minister of Supply.

D.H. ACQUISITION.—Control of the Commonwealth Government aircraft and engine factory at Lidcombe, N.S.W., Australia, has been given to de Havilland Aircraft (Pty.), Ltd. The Commonwealth Aircraft Corpn., Pty., has managed the factory since early last year. The propeller and engine servicing activities of de Havilland will be concentrated at the Lidcombe factory.

MALKARAS ORDERED. — Thirty Malkara anti-tank missiles have been received in Britain for acceptance trials and 150 more are on order. This radio-guided missile, which weighs 200 lb., has been developed in Australia. It can be fired from fighting vehicles.

VICTORS GROUNDED. — Handley Page Victors have been temporarily withdrawn from service for inspection following the discovery of a cracked member in the tailplane of one aircraft. Inspection and any necessary repairs should be completed by early September. Just before this defect was discovered the Victor had completed its R.A.F. intensive flying trials, totalling 1,000 hr., on schedule.

BANG-ON BOMARC. — Launched from Cape Canaveral, Florida, by remote control from Kingston, New York—1,500 miles away—a Boeing Bomarc missile successfully intercepted a target aeroplane over the Atlantic on August 15. On a previous occasion a Bomarc failed to intercept because of a fault in the guidance system.

Commercial Aviation Affairs

ECONOMY STATISTICS.—In the first three months of economy-class services on the North Atlantic, 59.6% of all traffic carried was of this new category. First-class and tourist traffic was almost equal at 21% and 19.4% respectively. In the second quarter of 1958, 335,615 passengers flew on scheduled North Atlantic service, an increase of 24.6%. More than 110 flights a day were averaged in June.

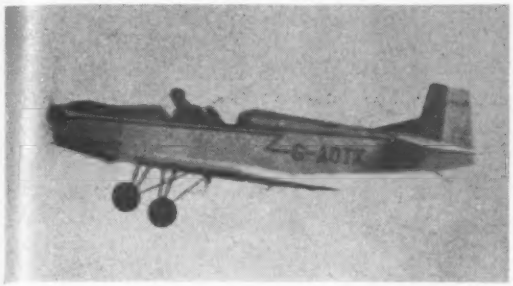
LUFTHANSA GROWTH.—A comparison of Lufthansa's results for the first six months of 1958 with those for 1957 shows some remarkable traffic increases which are attributable to increased North Atlantic frequencies and to the opening of new routes in Europe and to South America. Passenger numbers, for instance, increased by 55% and freight loads by as much as 73%.

AFRICAN AGREEMENT.—The Central African Airways and East African Airways Corporations have agreed to a pooling arrangement on regional services in East and Central Africa.

BOEING 707 DELIVERED.—Pan American were to take delivery of their first Boeing 707 on August 15, at Seattle, several months ahead of schedule. On August 21, it was to go into service on a New York-San Juan crew training run. Atlantic services are expected to begin on November 1.

NEW A.T.C. SCHOOL.—International Aeradio are to open an air traffic control training school in October. The syllabi will be similar to those at the school run by the M.T.C.A. and the first course will be a primary one in approach and aerodrome control, and applicable to students who have only a general knowledge of aviation. Practical training will be given on an A.T.C. synthetic trainer. The courses will be held at the I.A.L. premises at Hayes Road, Southall, Middx.

10,000-HR. VISCOUNT. — One of Trans-Australia Airlines' original six Viscounts has completed 10,000 flying hours—the first Viscount, it is believed, to do so.



STUDENTS' FIRST. — As noted last week, the Turbi two-seat ultra-light monoplane, G-AOTK, built by the T.K. Flying Group, made its first flight on August 9. It is here airborne in the hands of Mr. Pat Fillingham.

AIR CHARTER RECORD.—During July the traffic on Air Charter's Channel Air Bridge vehicle services exceeded previous records. A total of 3,500 vehicles and 12,000 passengers was carried from Southend to Calais, Ostend and Rotterdam. Traffic so far this year is 40% up on last year's figures.

COMET PLANS.—It has now been officially stated by B.O.A.C. that, so far as can be foreseen, the Comet 4 will enter passenger service on a weekly first-class de luxe London-New York service "by about the beginning of December." The frequency would "soon" become a daily one. From May, 1959, four weekly Comet services will be flown to Tokyo, via Hong Kong, and in December, 1959, Comets will take over the London-Sydney service.

U.S. ACCIDENT.—Late on the night of August 15, a Northeast Airlines Convair 240 crashed while making an approach to Nantucket Island Airport, Mass. Among the 23, of a total complement of 34, who lost their lives was Mr. Gordon Dean, former chairman of the U.S. Atomic Energy Commission.

Next Week

THE August 29 issue of THE AEROPLANE is our annual British Aircraft Industry Number and will be enlarged to 74 pages. In addition to the usual features it will contain a 32-page colour supplement of aircraft, engines and missiles, a special article on Britain's research and development facilities, a graph of British Export trends and a preview of the stands at the Society of British Aircraft Constructors Show.

This issue will cost 2s. 6d. and will be available from all bookstalls and booksellers, or direct from the publishers, Temple Press Limited, Bowling Green Lane, London, E.C.1.

THE BENGHAZI ACCIDENT.—Preliminary investigations have shown that there is no reason to suspect airframe or engine defects as possible causes of the accident to the Central African Airways' Viscount at Benghazi on August 8.

News About People

WASHINGTON APPOINTMENT.—Mr. C. N. Jaques has been appointed deputy head of the Ministry of Supply staff and director, Guided Weapons and Electronics, at the British Joint Services Mission in Washington, D.C., as from October.

HELICOPTER AWARDS. — Alan Marsh Memorial Trust Fund awards have been announced by the Helicopter Association of Great Britain as follow: Lieut. Cdr. G. G. R. Miller, R.N., receives the Alan Marsh Medal, which is awarded to a British pilot in recognition of outstanding helicopter pilotage achievement. He flew a hospital case from Gatwick to Halton at night and in extremely adverse weather conditions on December 16. The Alan Marsh Award, given to a British student who has shown exceptional ability in technical study in the rotary wing field, goes to Mr. K. F. Topp.

C.A.A. APPOINTMENT. — Capt. Michael O'Donovan has been appointed operations manager of Central African Airways. Previously in the S.A.A.F. and R.A.F., Capt. O'Donovan joined C.A.A. as a pilot in June, 1946, and was appointed chief pilot in March, 1951.

CANADIAN APPOINTMENT.—Mr. R. W. Dodd has been appointed to the position of chief of the Air Traffic Control Division of the Canadian Department of Transport. He had been an executive pilot and inspector with the Department following a long career of professional flying—including a period as ferry pilot with Silver City Airways.

MALCOLM LOCKHEED.—The death of Mr. Malcolm Lockheed, one of the founders of the Lockheed Aircraft Corpn., occurred recently at Mokelumne Hills, Calif. He was 70. He sold his interest in the company in 1930.

Military Aviation Affairs

METEOR CONVERSIONS. — Armstrong Whitworth Aircraft, Ltd., is to convert an undisclosed number of R. Danish A.F. Meteor NF.11s into TT.20s for target-towing duties. Work has started on the first two aircraft. Several other countries are showing interest in the conversion.

HILLER ORDER.—The U.S. Army has awarded a $5,470,000 production contract to the Hiller Aircraft Corpn. for 108 H-23D Raven three-seat helicopters (250-h.p. Lycoming engine). They are to be used in training, observation, reconnaissance and evacuation rôles.

HERCULES SALES. — The total announced orders for the Lockheed C-130B Hercules is now 57. The latest contract is for two additional SC-130Bs for the U.S. Coast Guard, which brings this force's total planned establishment to 14.

M.A.A.F. CHANGES.—The Malayan Government has asked the R.A.F. to arrange for the transfer of the command of the Malayan Auxiliary Air Force to its new commanding officer, Air Cdre. N. C. Hyde, C.B.E. The fighter control units of the Kuala Lumpur and Penang Squadrons are to be converted to aircraft control units, but remaining under the command of the M.Aux.A.F.

MAINTENANCE COMMAND.—As part of the redeployment of R.A.F. units, No. 24 Maintenance Unit at Stoke Heath, Salop, is to be moved to Sealand, Chester.

DEFENCE COSTS. — The Aircraft Industries Association of America, Inc., has announced that the material inventory of the U.S. Department of Defense—covering aircraft, missiles, ships, tanks, and so on, is valued at more than $100 billion. The Department spends about $7 billion yearly on maintenance operations—roughly $20 million a day. Military and civilian personnel involved total 800,000. These are U.S. billion=1,000 million.

HORSE TAILS.—Russia's Yak-24 helicopters (code-named Horse) now have fins at the end of a dihedral tailplane, replacing the earlier vee tail-surfaces.

The Comet 4 takes off at New York International Airport, Idlewild, during the noise-level assessment trials last week.

Atlantic Comet

THE headlines last week about the fast Atlantic crossing by the de Havilland Comet 4 were a comfortingly vigorous reminder of the fact that the World's first turbojet transport is now almost back in the airline business. The real point of this particular flight was not so much that a good, fast time was recorded, but that it was the first time that the Atlantic had been crossed by a production turbojet transport and that such a transport had made a non-stop flight between a North American and a European capital.

This flight was, in fact, typical of those which, in reasonably normal conditions, will be made with the Comet 4 when this aircraft goes into service later this year with B.O.A.C. on the North Atlantic run. It was made as a natural and even routine part of a trip to and from New York International Airport in connection with tests by the Port of New York Authority.

The results of these noise-level tests are not likely to be known for a fortnight or so, but since the Comet 3, with the same engines, was provisionally approved for operation in and out of Idlewild, there is no reason to expect any particular difficulties—apart from the possibility that certain runway directions and routings may be laid down.

G-APDA, the first production Comet 4, had left Hatfield on Sunday, August 10, with so little beating of drums that the first published information about the trip appeared in the newspapers under New York datelines. It left at 09.00 B.S.T., made a refuelling stop at Gander, Newfoundland, and reached Idlewild in an elapsed flight time of 8 hr. 53 min.

On Monday the noise-assessment tests were made after a briefing session involving about 30 persons in all. The weather was fair, but the fact that the Comet could make, as it did, a succession of fly-overs and take-offs in an area as busy as that around Idlewild, shows that the air traffic control and other authorities were both on their toes and being just as helpful as they could be. In all, eight fly-overs, two take-offs (on different runways) and two overshoots were completed. The first take-off was made at maximum weight and fuel was dumped in two stages before the landings.

Special crews with measuring instruments were assigned by

A few minutes after the return of the Comet to Hatfield—from left to right are Mr. Peter Buggé, Mr. Peter Wilson, Gp. Capt. John Cunningham, and Capts. N. A. Mervyn-Smith and S. S. Ward, and Navigating Officer C. T. Farndell of B.O.A.C. Among the "passengers" was Mr. F. B. Greatrex of Rolls-Royce.

Photograph copyright "The Aeroplane"

the P.N.Y.A.'s acoustical engineers to points around Idlewild Airport in line with, or adjacent to, the runways used in the tests. Some were positioned well into the nearby suburban districts of Howard Beach, Queens, and Cedarhurst and Meadowmere Park, Long Island.

On Tuesday, August 12, the Comet left the apron at Idlewild at 12.13 hrs. B.S.T. and was airborne at 12.24 hrs. B.S.T. (07.24 hrs. local time). At 18.40 hrs. B.S.T. it was overhead at Hatfield and the touchdown was made on runway 24 at about 18.50 hrs.

With the help of a favourable average wind component of about 50 knots, G-APDA had covered a Great Circle distance of about 2,990 nautical miles (3,440 statute miles) in a time of 6 hr. 26 min.—at an average ground speed of about 465 knots (535 m.p.h.) when making no allowance for A.T.C. deviations after leaving New York or for about 10 minutes' let-down and final approach time at Hatfield. The fastest previous commercial crossing, New York-London, had been made by an El Al Britannia 313 on January 8 this year in a time of 7 hr. 44 min.

The Comet had taken off at maximum weight with full tanks and after the 6¼-hour flight sufficient fuel (14,000 lb.) remained for about two hours' cruising at altitude.

So the Comet has been the first of the new generation of turbojet transports to make the North Atlantic crossing. Whether it will be the first to make a commercial crossing in airline service remains to be seen. Subject to a clarification of the noise situation it appears possible that Pan American, with Boeing 707-120s, and B.O.A.C. may start turbojet Atlantic services on the same date.

Both operators are, according to a U.S. correspondent, making matching Press advertising claims that they will operate the first scheduled turbojet passenger services across the Atlantic. B.O.A.C. has now stated that once-weekly, de luxe services, London-New York, are to start "about the beginning of December."

Meanwhile, P.A.A. have started a series of training and development flights with a production 707-120 on the New York-San Juan (Puerto Rico) run. The Port of New York Authority have given permission for the 707 to use Idlewild for these flights, though, at present, with a restricted weight.

Above, the Comet 4 a second before its touchdown on Hatfield's runway.
Right, the Rolls-Royce silencers of the Avon 524s.
Below, the Comet taxies in past Hatfield's control tower.

Photographs copyright "The Aeroplane"

Air Transport

Airline Policies Under Fire

LESS than a week after American Airlines announced their startling plans to purchase another 50 jet transports in the period 1960-62 (see THE AEROPLANE for August 15), the U.S. airline industry's re-equipment plans were criticized in a significant, independent report submitted to the White House.

This report, prepared at the request of Mr. Elwood R. Quesada, presidential special assistant, is the work of Dr. Paul W. Cherington, an air transport economics expert at the Harvard School of Business Administration and former consultant to the U.S.A.F. on air transport matters. Dr. Cherington is also working on a longer study than that just issued, but covering largely the same ground; this was started as a "private venture" at the Harvard School earlier this year.

The Cherington report to the White House focuses attention on two specific problems. These are, first, that the major U.S. airlines still require to arrange financing for $763.7 million to pay for the 390 turbine transports and additional piston-engined equipment ordered up to June, 1958; and secondly, that there "is at least room to doubt" that the necessary traffic can be generated to make the enlarged capacity economically sound. By 1962, the new equipment ordered up to June, 1958, will be generating 65,000 million seat-miles, plus 18,000-27,000 million seat-miles generated by what remains of existing piston-engined equipment.

At the 1956 average load factor of 64%, passenger traffic would have to total between 53,000 and 60,000 million passenger-miles to utilize this equipment economically. Against this, the most recent traffic estimate by C.A.A. for 1962 is 49,000 million—based on an annual growth rate of 10%. Although this growth rate was easily exceeded from 1948 to 1955, it has been falling off since then and, the report says, "traffic growth has stopped completely" at present. Even allowing for the (presumably) temporary effects of the U.S. business recession, Dr. Cherington believes many carriers will find it difficult to get back to and maintain an 11-13% growth-pattern necessary to justify their present re-equipment plans.

Where can the additional passengers be found? "Greater credibility could be given to the carriers' traffic forecasts," the report says, "if they could identify the new classes or types of customers who they believe will provide the almost doubled volume of traffic. . . . New markets must be discovered through research, and then exploited." The necessary growth will not come about "if the only marketing action which the carriers contemplate is price increases." Indeed, additional reduced promotional fares, especially those applicable during off-peak travel periods, might well be introduced, and new passengers attracted by cutting some fares.

So far as finance is concerned, the report shows that equipment and facilities which the airlines propose to buy over the next five years will cost $2,800 million. About half of this total may be obtained by sale of equipment, from profits (at 9% less dividend) and other sources, leaving $1,400 million to be raised by loans or equity financing. Up to April, 1958, arrangements had been made for less than half of this money to be made available. Whilst some of the outstanding sum will certainly be raised in due course, there is doubt, the report says, as to the financing ability of the carriers concerned on at least $500 million of the $763 million shortfall.

The actual needs of individual carriers were listed in the report, with the note that these figures might be conservative.

They showed financing required, but not yet arranged, to be as follows:—T.W.A., $313.3m.; Pan American, $115.3m.; Northwest, $63.5m.; Capital, $53.5m; National, $47.5m.; American, $31.9; Delta, $28.8m.; Northeast, $26.3m.; Eastern, $22.6m.; Panagra, $18.0m.; Continental, $17.8m.; Western, $17.2m. and United, $8.0m. These figures applied at June, 1958.

The report makes it clear that the U.S. Government cannot afford to stand by and let the airline industry fail in its re-equipment plans. Not only is a strong national airline system required for defence, postal and commercial needs but the new transport aircraft programmes represent a major factor in the aircraft manufacturing industry and, through the 120,000 people they will employ directly, in the national economy.

Ways in which the Government can help, suggests the report, include passenger fare adjustments (both increases and reductions), necessary to improve the earning levels and restore the confidence of investors; a study by the Air Co-ordinating Committee or the Operations Co-ordinating Board of the ways in which the sale of older U.S. commercial aircraft abroad might be facilitated; a resolution of the issue of allocating M.A.T.S.-controlled traffic between M.A.T.S. and commercial airlines; and further consideration of a repeal or reduction in transportation excise taxes paid by the carriers.

The Tide Recedes

AS we forecast in the issue of July 25, p. 126, on a basis of comments in last month's *B.E.A. Magazine*, the Corporation's results for June were even more disappointing than those for May.

B.E.A. TRAFFIC RESULTS FOR JUNE.

	June 1958	June 1957	Variation
Capacity ton-miles offered	18,191,000	16,576,000	+ 9.7%
Load ton-miles sold	10,805,000	10,849,000	— 0.4%
Revenue load factor	59.4%	65.5%	— 9.3%
Passengers carried	294,343	314,885	— 6.5%
Passenger-miles flown	101,588,000	104,432,000	— 2.7%
Passenger load factor	61.9%	72.5%	—14.6%
Freight ton-miles	948,600	793,400	+19.6%
Mail ton-miles	287,800	266,700	+ 7.9%
Aircraft miles flown	3,728,000	3,499,000	+ 6.5%
Revenue hours flown	20,649	20,094	+ 2.8%

The table above shows these figures and compares them with those for the same month last year. It will be seen that there was a slight drop in the ton-miles sold and that the capacity showed a smaller increase than might normally have been offered. The overall load factor dropped from 65.5% to 59.4%, but freight ton-miles showed a useful increase of 19.6%.

The K.L.M. Disaster

SOME conception of the price that may have to be paid for the use of large-capacity units, in a transport medium which still has its unknowns, was shown last week. The K.L.M. Lockheed L-1049H, which was lost after leaving Shannon Airport on the morning of August 15, had on board 91 passengers and eight crew members. All must be presumed to have lost their lives.

The Super Constellation, which was on its way from Amsterdam to New York, via Shannon and Gander, left Shannon at 04.05 hr. and did not make routine contact with Shannon an hour later. Thereafter nothing more was heard from the crew or known about the fate of the aircraft until R.A.F. Coastal Command Shackletons, led to a position given by a B.O.A.C. DC-7C, sighted wreckage about 120 miles west-north-west of the airport.

Evidence at the time of going to press suggests that the accident occurred at about 04.45 hr. and that it was of a sudden and catastrophic nature.

Parachuting Championships

John Fricker's Second Report from Bratislava

FOR some inexplicable reason, the Czech Aero Club halved the scheduled two-week programme for the Fourth World Parachuting Championships, which were, therefore, very exhausting for the contestants. It was necessary to be out at Vajnory airfield at 07.00 hrs. every morning, for each team to complete two jumps during a 12-hr. day, which also included repacking and maintaining parachutes in between times. On one occasion, a few of the teams were required to begin jumping at the incredible hour of 05.00 hrs., and apart from one official rest day, the only respite came with a further and welcome day of bad weather.

Another complication was a shortage of individual transport, which resulted in much time being wasted while waiting for coaches to fill up, after an initial stampede. Once in the air contestants also had to spend about 45 min. to get up to 8,000 ft. in the heavily loaded An-2s, although, fortunately, only two jumps in Event Three had to be done at this height. Apart from its poor climb, the An-2 is otherwise ideal for parachuting, with excellent slow-flying qualities, but from the pilot's point of view it needs careful flying at aft C.G. positions (with up to 12 or 13 people on board) when the stability deteriorates noticeably.

At the dropping speed of about 110 k.p.h. (68 m.p.h.) the rate of sink becomes very rapid as power is reduced, so that a careful compromise is necessary between avoiding excessive slipstream during the parachutist's exit, and falling below the height (checked by barograph) for the event. An excessive height margin, on the other hand, seriously upsets the parachutist's calculations.

The normal aiming technique was for the pilot to fly a previously agreed run into wind, aligning the target cross along the edge of the An-2's overhung port window, and the parachutist from the open door to give minor last-minute corrections as the cross disappeared from the pilot's view. Depending on wind strength, the jump was then made at a previously estimated number of seconds past the cross, each parachutist having a stop-watch and an altimeter on a small instrument panel above the reserve pack.

Most of the teams, including our own, adhered to this technique, using either (and preferably) a microphone above the door or hand signals via an intermediary to relay corrections, but the Russian parachutists were dropped, like bombs, entirely on the judgment of their pilots by means of a buzzer. This system was used by the Czech co-pilots who accompanied all the teams, for Event Three—the free-falling contest—which did not involve a spot landing.

The British team found disadvantages in both of the former methods of signalling. On one occasion the microphone packed up without the pilot's knowledge (the system being one way) so that two of the parachutists were dropped without last-minute corrections, while the misinterpretation of hand signals at another time resulted in Sue Burges having a distinctly peculiar run-in.

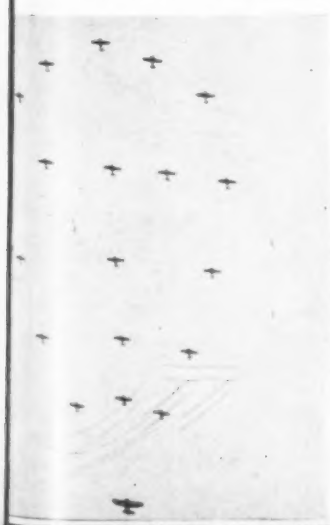
Event Three, on August 5, was won by former World Champion Gustav Koubek of Czechoslovakia, among the men, and Bacaoanu of Rumania for the women. They gained the most points for style in 40-sec. free fall and for the turns, which were done according to a brief ground signal displayed after the parachutist had left the aircraft, and also received a bonus for the rapidity with which these were completed.

Contestants not wishing to attempt the turns were awarded points for stability while falling on a constant heading. Most of the British team did not attempt turns and none, in fact, gained any points for them, but all gained marks for style.

Virtually no opportunity had been possible for our team members to practice even delays of this magnitude, because of the difficulty of finding a suitable dropping area outside airways or control zones, and the contest therefore provided priceless experience although no possibility of an outstanding performance. An even more graphic illustration of the odds confronting the unsubsidized British team, which had an average experience level of about 80 jumps, was the fact that in training for the contest alone, every 800-1,000-jump member of the Russian team made *150 descents* with the same pilots in a practice session in the Crimea.

The U.S. team had also been given excellent practice facilities, in addition to substantial financial backing, the Army and Air Force passing special regulations permitting its civilian members to jump from L-20 Beavers, U-1 Otters, C-47 Dakotas and

(*Continued on page* 275)



Photographs copyright "The Aeroplane"

Left, C-106s and an An-2 pattern-fly a parachute to open the contest. Above, individual men and women winners Ostrowski and Priachinova (U.S.S.R.) with their runners-up. Below left, Fricker, McLoughlin, Burges, Lee and Reilly of the British team. Right, Sue Burges lands near the cross.

HANDLEY PAGE 111 MILITARY TRANSPORT

DEVELOPED from the Victor bomber, the H.P.111, or Treble One, is a projected military transport unique in combining long-range strategic operation at 545 m.p.h. with the tactical ability to land on 1,000-yd. grass airstrips.

As a long-range strategic transport it operates at 240,000-lb. all-up weight and carries a 53,000-lb. payload over a still-air range of 3,300 nautical miles. In the tactical rôle it can be used as a troop transport, freighter and paratroop or supply-dropping aircraft; at 180,000-lb. all-up weight it will use 1,000-yd. grass airstrips.

The need for such an aircraft was underlined recently by the Cyprus airlift, when 3,500 men and more than 90 tons of stores were flown from Britain in five days by 45 aircraft. The same task, it is claimed, could have been completed by six H.P.111s in only two days—or in 7 hr. if 27 such aircraft were used. The H.P.111s could also have been used for tactical operations in the Middle East.

Information about this interesting project has been given by Handley Page, Ltd.; further details were revealed in an interview with the company's technical director, Mr. R. S. Stafford, C.B.E., F.R.Ae.S. The H.P.111 makes a particularly interesting study because of its close relationship to the Victor.

Handley Page states that if the H.P.111 were ordered now it could be in service by the end of 1962. Its development from the Victor—presumably the Victor 2—means that it could be produced relatively quickly and cheaply. It is powered by four Rolls-Royce Conways and has a wing and tail virtually identical with those of the Victor.

The background to its design was given by Mr. Stafford. Although no specific operational requirement has yet been issued for such an aircraft, its design was based on an indication of probable needs received from the Air Staff.

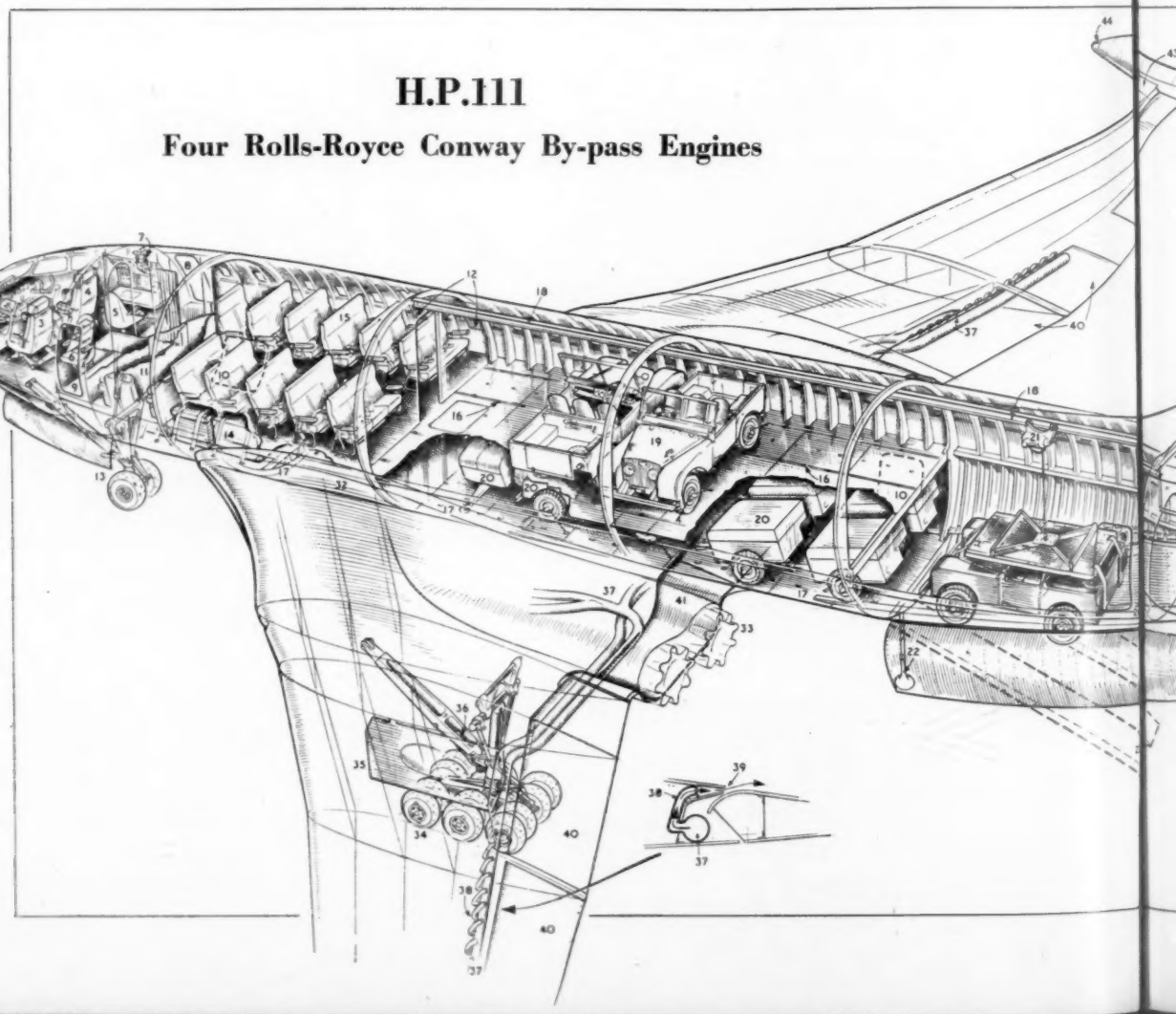
The size of the vehicles to be carried dictated the fuselage diameter of 15 ft. 6 in.; a circular fuselage was chosen because of pressurization requirements. It was decided that large rear doors were essential, both for the loading of vehicles and the air-dropping of heavy freight and supplies. Although very large, these loading doors have been designed to carry the high pressurization loads and do not involve any great weight penalty.

In discussing the design of the new aircraft for tactical operation from 1,000-yd. grass airstrips, Mr. Stafford said that no great difficulties were involved. All-up weight was reduced to 180,000 lb., which gave a wing loading of 64 lb./sq. ft. Compared with the Victor the wing span and area were effectively increased by the larger-diameter fuselage and the wing-tip tanks also produced a beneficial effect.

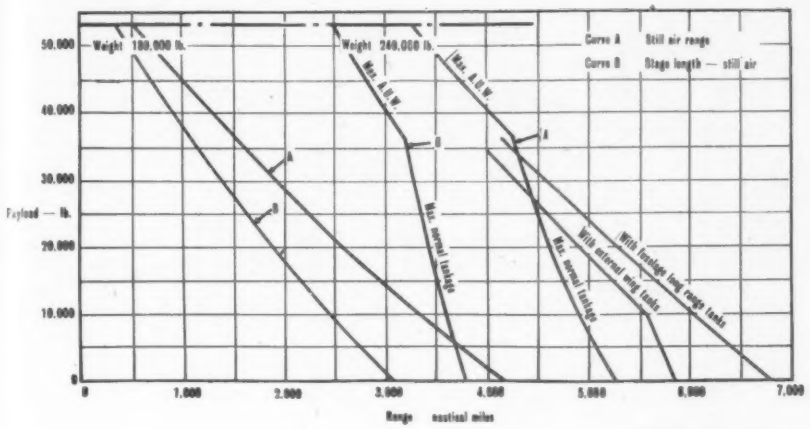
The H.P.111 wing has the same sections, twist and planform as the Victor wing, but there is a minor increase in chord near the tip. The Victor's movable nose flaps have been replaced by a fixed leading edge which is slightly drooped.

For operation from short grass strips the landing performance involved more design problems than the take-off. Primarily to meet landing requirements the

(*Continued on page* 275)



Range and Payload



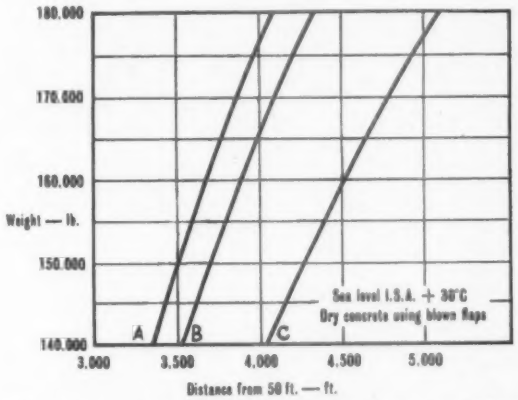
TECHNICAL DATA

DIMENSIONS. — Wing span (including tip tanks), 130 ft.; overall length, 137 ft. 8 in.; overall height, 35 ft. 3 in.; main cargo-hold dimensions, 40 ft. by 11 ft. 6 in. by 11 ft. 6 in.; forward hold dimensions, 12 ft. x 9 ft. x 6 ft.

WEIGHTS. — Max. take-off weight, 240,000 lb.; max. wing loading, 85 lb./sq. ft.; max. take-off weight from short airstrips, 180,000 lb.; max. landing weight, 180,000 lb.; basic equipped weight, 112,000 lb.; max. zero-fuel weight, 165,000 lb.

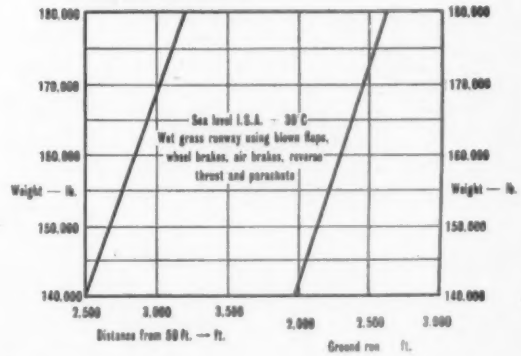
PERFORMANCE. — Take-off distance to 50 ft. at 240,000 lb., I.S.A. + 30°C. (with water-methanol), 7,000 ft.; (without water-methanol), 8,120 ft.; landing distance from 50 ft. at 180,000 lb., I.S.A. + 30° C. on wet runway, using brakes, parachute and reverse thrust, 4,270 ft.; cruising speed at 50,000 ft., 545 m.p.h. T.A.S.

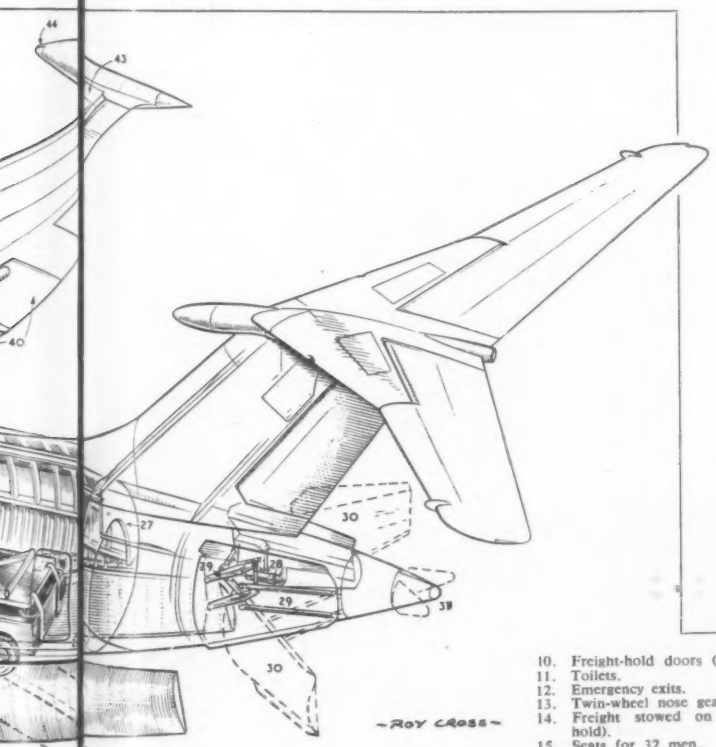
Tactical operation from 1,000-yd. grass airstrips; long-range strategic operation from normal airfields



Landing distance from 50 ft., using, A, wheel brakes, air brakes, reverse thrust and braking parachute; B, wheel brakes, air brakes and reverse thrust; C, wheel brakes and air brakes.

Assault landing technique





KEY: H.P. 111

1. Weather-radar scanner.
2. Pitot head.
3. First pilot.
4. Second pilot.
5. Engineer's station.
6. Navigator's station.
7. Sextant.
8. Emergency exit.
9. Entry door.
10. Freight-hold doors (st'b'd s'de).
11. Toilets.
12. Emergency exits.
13. Twin-wheel nose gear folding forward.
14. Freight stowed on lower deck (freight hold).
15. Seats for 32 men.
16. Movable upper floor with seat rails, attachment and lashing points.
17. Fixed lower floor.
18. Rail for travelling hoist.
19. Upper deck has space for six ¼-ton Land Rovers.
20. Lower deck has space for one Land Rover and seven 10-cwt. trailers.
21. Travelling hoist for loading upper deck.
22. Fuselage-support jack.
23. Movable ramps for loading lower deck.
24. Rear loading doors.
25. Door operating jacks (five per side).
26. Rear personnel doors.
27. Fin support structure.
28. Air-brake operating jack.
29. Air-brake extending linkage.
30. Air-brake open position.
31. Braking parachute stowage (doors in open position—dotted).
32. Wing structure through fuselage.
33. Jet-engine silencers.
34. Twelve-wheel main landing gear bogie.
35. Undercarriage fairing door.
36. Undercarriage operating jack.
37. Air ducts for flap blowing.
38. Blowing-nozzle connecting-pipes.
39. Blowing nozzle.
40. Trailing-edge blown flaps.
41. Inboard flaps extend beneath fuselage
42. Wing-tip fuel tank.
43. Outer-wing extension for tank mounting.
44. Navigation lamps in tank nose.

CANADIAN AVIATION TODAY

Post-War Air Transport in Canada

by Neil A. Macdougall, B.A.Sc., P.Eng.

IN 1939 Canadian airlines carried twice as much air freight as American carriers. The two figures are now more in line with the relative populations of the two countries, but the early statistics illustrate the importance of air transport to a vast, undeveloped country. Nowhere has air transport been of more importance to the economy than in Canada's Northland.

As a Government pamphlet says, "The history of transportation in the North-west Territories can be divided into two periods, before and after the aeroplane. In the days before air travel annihilated distance, transportation was always slow and difficult, often dangerous. The broad highway of the Mackenzie River offered fairly easy access into the heart of the North, but it was open for only a few months of the year, and to strike out overland meant a constant struggle with rock and muskeg in summer and pressure-rigged ice in winter. Even a relatively simple trip meant weeks of preparation and months of heart-breaking effort."

The only road into the North-west Territories stops at the South shore of Great Slave Lake, far from the trading posts on the Mackenzie. Rivers and lakes are frozen for all but three or four months a year. Perishables, or anything that misses the last boat north in October, must remain at Waterways throughout the long winter. Consequently, staples are shipped in during the summer, but the shortness of the navigable season and the cost of long storage often outweigh the cheapness of water-transport. An appliance dealer in Yellowknife (N.W.T.) thinks nothing of flying in his stock of gramophones.

The rapid post-War growth of aviation in Canada can be understood only in the knowledge of the services which existed before the War. Although the bush pilots had built a legendary reputation with their runs to isolated northern communities and mining camps, scheduled services were few and scattered. Since Trans-Canada Air Lines was incorporated by an Act of Parliament in April, 1937, it has expanded its routes from 122 miles to more than 26,000 miles.

In July, 1937, the first survey flight for the proposed trans-continental route left Vancouver, and by September a service to Seattle was inaugurated with a 10-passenger Lockheed Electra. Vancouver to Montreal service was started in April, 1939, with Lockheed 14s, and extended to the Maritimes the following year.

During the War, traffic was restricted by both emergency regulations and the lack of available aircraft and equipment, as well as by the absence of qualified personnel who had flocked to the Air Force. It was not until 1946 that regular inter-city commercial service became commonplace. By 1948 over 80% of the passenger miles flown were on inter-city services which did not exist before 1939. In the same period, total aircraft miles rose from 11,000,000 to 38,000,000.

Many ex-Servicemen were eager to try their hands at airline operation. War-surplus aircraft were cheap and charter airlines and fixed-base operators mushroomed on the dozens of lakes and deserted Air Force stations. Although the Air Transport Board sought to create a climate in which expansion was orderly through its control of routes, licences, fares and rates, many of the names which appeared on early post-War lists are missing. Often operators had more enthusiasm and flying ability than knowledge of accounting and management. The financial difficulties were not confined to the small companies, however, and even today some large firms do not seem to appreciate the benefits of aircraft standardization. It was not until 1950 that the industry posted a profit. For seven years prior to 1950, there was a net loss, with a peak of $2,487,412 in 1947. Rising costs and the need for expansion forced several important mergers.

Meanwhile, T.C.A. acquired 27 War-surplus Dakotas, had them converted to carry 21 passengers, and extended routes in both Canada and the United States. In 1947 the first of 20 Canadair DC-4M North Stars was delivered. With Rolls-Royce Merlin engines, they carried 40 passengers, then 48 and, for tourist services, 54 and now 62. The Noisy Stars, as they became known to the travelling public, brought greatly

In this special supplement, THE AEROPLANE *presents its annual review of Canada's aircraft industry. The present situation of the aircraft manufacturing and transport industries and the fighting services are discussed in three separate articles, and the principal aircraft now in production or development in Canada are described in greater detail. There is also a directory of the ancillary industry.*

The great expansion of air services in Canada quickly made the army huts which served as terminals at many points, inadequate. This administration building at Calgary's Municipal Airport, McCall Field, was among the first to be completed by the Dept. of Transport.

Newest equipment in service with Canadian airlines is the Bristol Britannia now used by Canadian Pacific on their arctic service to Europe and westwards to the Orient. The first of the fleet is seen outside the new Britannia hangar at Vancouver.

increased speed to the main-line services, and enabled T.C.A. to inaugurate a trans-Atlantic service. Lancastrians had been used earlier. Service was later extended to Paris, Dusseldorf, Tampa (Fla.), Bermuda, the Caribbean and Mexico City. Super Constellations replaced the North Stars on most overseas runs in 1954.

T.C.A. carries almost 90% of all Canadian domestic traffic, a share which has been gradually increasing over the past 10 years. T.C.A. traffic has increased more rapidly than the World average and the U.S. domestic rate in six of the past 11 years, less rapidly than the other two rates in four years, and had an equal growth in the remaining year.

As for the future, T.C.A. is assuming that traffic will continue to grow at an annual rate of more than 15% up to 1960, that there will be a 23% increase in 1961 when substantial fare reductions are planned, and that an increase of 12% each year will be sustained during the subsequent five years. T.C.A. is thus estimating that its total traffic in 1961 will be 96% higher than in 1957. This compares with a forecast by U.S. domestic air lines of a 65% growth.

To handle this traffic, T.C.A. has undertaken a $140,000,000 re-equipment programme. The original order for 15 Viscounts has been increased in stages to 51, while 20 Vickers Vanguards and six Douglas DC-8s have been ordered for the medium- and long-range routes.

T.C.A. was the first North American operator of the Viscount, and President G. R. McGregor has said that its passenger appeal "has exceeded our most optimistic estimates." Its operating cost is 9% below the original 1953 calculation. Carrying specific charges for depreciation, its cost per seat-mile is still less than those of larger aircraft which have been fully depreciated.

As the brain-child of the Liberal administration and of the Hon. C. D. Howe, the Minister of Trade and Commerce, in particular, T.C.A. was long the Government's "chosen instrument." At one time it was thought that all international services would be T.C.A.-operated.

However, the Canadian Pacific Railway, whose pre-war white Empress liners were well known in Britain, Australia and the Orient, had long sought international routes for its aggressive subsidiary, Canadian Pacific Airlines. Eventually, the Government weakened, and permitted C.P.A. to inaugurate a service to Japan, Hong Kong and Australia in 1949. These routes have since been extended to Mexico, Peru, the Argentine, and over-the-Pole to Amsterdam.

The present route mileage is about 41,000, of which 6,915 is domestic. Passenger mileage has soared from 79,000,000 in 1950 to almost 318,000,000 in 1957. By the time this article appears, C.P.A. should have 15 Douglas DC-6Bs and six Britannias. The company would like to extend its Montreal-Lisbon route to Madrid and Rome, but T.C.A. is interested in the latter point, and nothing can be done until a bilateral agreement is negotiated. Another extension to China is likely as soon as political developments permit.

On the domestic scene, C.P.A. took over 10 independent bush airlines in 1942, with a polyglot collection of 77 aircraft of 14 types. Most of these were single-engined bush planes, since the countless thousands of lakes in the North made operations on floats and skis natural. However, these reduced payloads and meant suspension of operations during the spring break-up and the Fall freeze-up.

Before the War, Grant McConachie, now President of C.P.A., had recognized the benefits of wheeled operations and established a chain of airports between Edmonton and Whitehorse (Y.T.). Thus he was eager, at War's end, to replace the rugged Norsemen and Junkers with Lodestars and DC-3s, in which the passengers didn't have to be so rugged. The radio range, radio compass, instrument flight and procedure let-downs brought new meaning to schedules. Stewardesses were introduced, although on at least one run the loggers felt so at home that this amenity was removed. The larger aircraft made possible lower fares and freight rates, which stimulated traffic.

Reliability increased and the day when the passengers had to sleep in their aircraft while their pilot waited out the weather on some lonely, frozen lake all but disappeared. This improvement in equipment had a salutary effect on revenues too. Nevertheless, Northern services often had more romance than profit, and C.P.A. turned its thoughts to a trans-continental freight service.

When it made application in 1953, it was generally agreed that this was the first hopeful step toward obtaining trans-Canada passenger rights. The Government rejected the application, forcing C.P.A. to sell its two newly acquired DC-6As. Meanwhile, T.C.A., stung by the criticism which arose from the application, bought three Bristol 170s for its first all-freight service. It was not until 1955 that T.C.A. introduced a trans-continental freight run, using converted North Stars.

"This is Canada's Century," is more than a political catch-phrase. Natural resources development has been proceeding at an unparalleled rate; gross national production has been growing faster than in even the United States. This economic development has meant a great deal, not only to the firmly established lines like T.C.A. and C.P.A., but also to smaller scheduled airlines and the charter operators.

Indeed, it can be argued that the growth of the economy

On Canada's West Coast, where boat service is slow and infrequent, aircraft have done much to open up the hinterland. This Fairchild F-11 Husky is seen in a typical British Columbia scene at the gold-mining community of Zeballos.

Photograph by Neil Macdougall

Canadian Aviation Today . . . .

Austin Airways has been flying continuously longer than any other air line in Canada. Here is a company Noorduyn Norseman at the firm's headquarters on Ramsay Lake, Sudbury, Ontario.

and the airlines are interdependent. Magnetometer-equipped aircraft found the base metal deposits in New Brunswick, the iron ore of Ungava, the nickel of Manitoba. Aircraft speeded their development, and aircraft are servicing the completed mines. Kitimat, Moak Lake, Uranium City, Knob Lake—all the multi-million dollar projects which stir the hearts of even phlegmatic Canadians—owe much to air transportation. It is estimated that the helicopters of Okanagan Air Services saved a year or more on the construction of the Kitimat aluminium smelter and its associated power plant.

When other forms of transportation are slow or non-existent, the aircraft becomes the accepted mode of travel by people who would never fly in more densely populated areas. The Eskimo who has never seen a train or a street car thinks nothing of taking a C.P.A. Otter to visit his relatives at Fort Good Hope. A school principal charters a Cessna 195 to fly to Inuvik, to set up a new school. The Mounted Police and missionaries fly to their outposts. Eskimos are flown at Government expense to hospitals on James Bay, 700 miles away. Indians hire a Norseman to fly 10 months' supply of food to their trapping grounds, rather than make the arduous trip by canoe.

Canada's burgeoning economy has resulted in the use of aircraft for less serious pursuits. For example, hunting and fishing provide the main business for Austin Airway's Sudbury base. It is not unusual for a few friends to charter a Cessna 180 for a day-long fishing trip to some remote lake. During the Fall deer hunt 150 private and commercial hunting camps are supplied by air. In September, parties of 10 or 15 goose-hunters come from all over the Continent to be flown to Albany, on James Bay, in a Canso amphibian.

Aircraft are used not only to exploit natural resources, but also to replenish them. Excessive trapping by natives killed the last fisher, a marten-like animal, in the James Bay area 10 years ago. Fishers from other regions would eventually repopulate the district. This process is so slow, however, that the Ontario Dept. of Lands and Forests is flying the animals into the area, which can then be opened for trapping sooner. They will provide an important new source of income for the Indians, in an area where commercial fisheries are poor.

Farther north, Eskimos are dying because the nomadic caribou herds are diminishing. To determine the reason, the Government takes annual caribou counts, using aircraft chartered from Koenen's Air Service in Yellowknife. A Beaver of Pacific Western Airlines drops poisoned bait for the wolves which prey on the caribou.

Canada's increasing population and resource development have contributed to the steady, but not always profitable, growth of commercial air operations. Between 1946 and 1950, revenue aircraft miles flown rose from 25,844,600 to 39,901,900, and to 101,723,710 in 1956. Revenue ton-miles amounted to 1,892,400 in 1946, 6,420,700 in 1950 and 22,065,300 by 1956. In the same period, revenue passengers, goods, mail and revenue all rose steadily.

The large increase in activity in 1955 and 1956 is explained by the surge of effort connected with the construction of the Northern radar lines. Because of the urgency of the Distant Early Warning line programme, a way had to be found to transport heavy machinery, building materials, Diesel fuel and other essential construction supplies to the Arctic in the winter and spring, so that they would be on hand for the short May-to-September construction season.

Several of the Junkers and Fairchilds in which Canada's bush pilots became legendary are still flying. This 1927 Fairchild FC2W2, brought up to 71 standard, is based at Vancouver International Airport, and is seen on the Fraser River nearby.

Unlike Alaska, much of Canada's north was not suitable for overland "cat train" operation, so 42,000 tons of supplies had to be flown in. Lacking the resources for such a big airlift, Canadian carriers combed the World for freight aircraft. DC-3s from Iran, Yorks from Britain and DC-4s from the United States were bought or leased. Sixty-seven twin- and

(*Continued on page* 257)

All the materials and labour for the Pallisade Lake dam near Vancouver, B.C., were flown to the site in helicopters of Okanagan Air Services. During the construction, this Bell 47B3 dropped in on the Great Vancouver Water Board's caretaker.

Photographs by Neil Macdougall

Canadian Aviation Today . . . .

(*Continued from page* 256)

four-engined civil aircraft were used, apart from bush aircraft and some U.S.A.F. Globemasters and Packets.

Foul and frigid weather, a lack of navigation aids, the unknown nature of the country, the proximity of the North Magnetic Pole, and primitive ice strips contributed to the hazards of the operation. It is significant that the McKee Trans-Canada Trophy for 1955 and 1957 were awarded for work done in connection with the radar lines.

Construction of the later Mid-Canada Line brought additional work for the airlines, but with the completion of both lines, the volume of available work plunged. Some companies have been left with greatly expanded fleets, and high depreciation or leasing costs. And this at a time when the bottom has dropped out of the market for used aircraft, particularly older types like the Commando, DC-4 and York.

Meanwhile, Maritime Central Airways, the country's third-largest line, and Wheeler Airlines ventured into the non-scheduled trans-Atlantic business with DC-4s. Immigrant traffic made this lucrative for a time, but the new economy fares seem to have dried the market up. M.C.A. is believed to be attempting to sell the two DC-6s it purchased for this service.

High operating costs reduced the 1957 profits of the air lines to about one-fifth of the record 1956 surplus. Of the major airlines, C.P.A.'s domestic runs, Quebecair and TransAir suffered losses, while Pacific Western made a profit of only $83,700 on revenue of $6,829,000. Many of the airlines had working capital deficits in addition to losses. The plight of the regional airlines is serious.

The Wheatcroft Study

Great interest therefore attaches to a study conducted by the British airline economist, Stephen Wheatcroft, for Transport Minister Hees. In line with the policy promoted by the Conservatives when they were in Opposition, Mr. Hees has said that competition should be allowed domestically where economic conditions indicate that more than one carrier can operate without a subsidy. (THE AEROPLANE, March 14, 1958.) Mr. Wheatcroft's report has been released recently, a little prior to an Air Transport Board hearing which will consider the applications of C.P.A. and Pacific Western Airlines to operate trans-continental passenger services.

The report concludes that competition may offer customers a choice, better frequency, more direct flights and lower load factors. Costs may not be kept at the lowest level, however, because fixed fares may lead to product differentiation and therefore to increased costs. Competition might also force premature retirement of T.C.A.'s Super Constellations, if a competitor introduced Britannias, for example. The other possibility is that competition might force the use of a jet aircraft on the shorter stage routes on which T.C.A. plans to use the Vanguard, so increasing fares and costs. This danger would be avoided if the regulatory agency insisted on a premium fare for jet services on such routes.

In reviewing T.C.A.'s record, Mr. Wheatcroft says T.C.A.'s load factors have very often been higher than the 70-75% postulated as the maximum for adequate service. Insufficient capacity has been provided to meet traffic demands on many routes, and there is a *prima facie* case for believing that traffic has been turned away. T.C.A.'s future plans are based on the expectation of lower load factors; 68% has been used as the basis for ordering future aircraft.

The most serious weakness in present T.C.A. services is said to be the low level of frequency, relative to the desirable frequency. A departure interval equal to the time of flight is regarded as a good rule of thumb. (This seems an unreasonable criticism as the traffic generated must depend upon the size of the centres served.) Only four of the 21 major sectors on trans-continental routes have reached the desirable frequency. Over half the sectors have a frequency less than half the number desirable. It is in the direction of increasing frequency, rather than that of introducing new direct-flight connections (proposed by C.P.A.), that competition might do the most to improve service.

Mr. Wheatcroft points out that costs tend to fall as route volume increases, and hence competition may increase the average costs by splitting the volume between two or more carriers. Unlike C.P.A., he argues that competition itself does not induce more people to travel. However, traffic may develop with the introduction of more flights; the result is no different than if the original operator had increased his frequency.

His study of productivity indices shows T.C.A. to compare favourably with C.P.A., B.E.A. and American carriers. "Thus, although there may be room for a considerable reduction in the level of air-transport costs, it is by an intensification of the traffic density, rather than from competitive influences that this reduction will probably be achieved."

Tourist service was not introduced domestically by T.C.A. until February, 1954, five years after coach-class service started in the United States. Prior to 1954, T.C.A. was using North Stars on transatlantic and trans-continental flights. Competition would have forced the earlier introduction of tourist service and of more passenger-attractive aircraft.

One danger in competition he foresees is that new mainline capacity might be provided by a small airline (less than 50,000,000 available ton miles a year) with inherently high costs. It is estimated that P.W.A., which has applied for a trans-continental licence, would be at or below this figure.

Considering the traffic potential of Canadian routes, he concludes that only the Toronto-Montreal, Vancouver-Victoria and Toronto-Winnipeg sectors presently have enough traffic to sustain unrestricted competition without adverse economic consequences. But what of the future. The increase in average aircraft size on trans-continental routes up to 1961 is likely to be about two-thirds as large as the traffic growth. By 1966 the traffic growth will be significantly greater than the increase in aircraft size. Thus the Vancouver-Montreal route might have adequate potential to make competition worthwhile then.

Since Transport Minister Hees has said that competition must not have major detrimental effects on existing operations, Mr. Wheatcroft's conclusions on the effects of competition on T.C.A.'s finances are significant. Of all T.C.A.'s routes, only the transatlantic, Florida, Caribbean and trans-continental make money. The amount of profit that T.C.A. makes on its trans-continental services is therefore a vital factor in the present overall self-sufficiency of the airline.

If five daily, competitive trans-continental runs were authorized now and started in 1959, T.C.A.'s profit on the trans-continental runs would entirely disappear, the report estimates, resulting in an overall deficit of about $9,000,000. It concludes that the competitor would achieve a load factor of only 35%, and would suffer a loss. This analysis assumes that T.C.A. would continue with the planned expansion.

If T.C.A. were ordered to make room for another carrier, and keep its capacity at the 1958 level, a total loss of $5,000,000 might be expected. Two or three daily services would be the maximum a competitor could be allowed in 1959, and then T.C.A. would face serious problems of equipment disposal.

As a social obligation, T.C.A. operates a group of services which involve an annual loss of about $3,000,000. Such cross-subsidization discourages expansion in the direction of the lowest costs and the greatest potential demand, and encourages it beyond the most economic level where costs are high. The rate of traffic development would have been in the past, and could be in the future, much higher if trans-continental services were not obliged to subsidize low-traffic routes.

The report recommends giving these services, on a subsidized basis, to regional airlines already engaged in such secondary route operations. Some of these lines, such as TransAir and Maritime Central have long advocated such a policy, so Mr. Wheatcroft's recommendation will be satisfying to them.

"Incidental Competition"

If Mr. Wheatcroft does not give much encouragement to trans-continental competition, he does open the door to "incidental competition." For example, C.P.A. might be allowed to connect the termini of their overseas services with other Canadian cities. Private operators could provide peak capacity on such routes as Vancouver-Victoria, as is done in Britain. The present prohibition of non-scheduled flights over scheduled routes could be withdrawn.

With the report just in the Government's hands, predictions are dangerous. Mr. Hees is understood to favour the report, although the Conservatives once pleaded for trans-Canada competition. The regional operators may well get the relief recommended, although only two, Wheeler Airlines and Quebecair, have had enough confidence to order new equipment (Fairchild Friendships). Meanwhile, one large air-freight firm has gone bankrupt and other charter operators are in various stages of financial trouble. Some distress selling of aircraft seems inevitable, as firms pay the price of over-expansion, lack of standardization, bad management and poor luck.

As the Government wants to show signs of increasing competition, there is apt to be an easing of licensing restrictions on the 200 Class "C" carriers, who fly bush planes and light aircraft. There is now fear of excessive competition as operators who thought competition would be good for T.C.A. decide it would not be good for them.

It would be unfortunate if the Government's new policy, whatever it might be, were to undermine the already shaky air transport industry, as it has contributed far more to the growth of the economy than its capitalization and number of employees suggests.

Canadian Aviation Today . . . .

Aviation in Canada's Services

Our Canadian Correspondent discusses the basis of Canadian defence plans and some of the problems confronting the Services today.

MANY COUNTRIES in the World with populations much larger than Canada's 17,000,000 people must envy the Dominion's 1,900-aircraft air force. Yet Canadians, who have difficulty persuading themselves that anything wholly Canadian is really good, are not as impressed. And the Services themselves are too busy wrestling with the problems of the missile age and impatiently awaiting new equipment to rest on their laurels.

Like many small countries, Canada has concentrated on air defence. The expensive business of strategic bombing has been left to the major powers, and with the conversion of two Mitchell-equipped Auxiliary Air Force squadrons to transport units, the R.C.A.F. has no tactical bombers.

The mainstay of the Air Defence Command (Air Vice-Marshal L. E. Wray, O.B.E., A.F.C., C.D.) is nine all-weather fighter squadrons equipped with the Avro Canada CF-100 Mk.5, the latest version, with extended wings and tail units to increase its service ceiling. Except for 409 Squadron at Comox, B.C., all the units are stationed in Ontario and Quebec, the most populated and industrialized provinces. The CF-100 Mk.6, which was to have had afterburners and Sparrow 2 guided missiles, has been cancelled as an economy measure, although the possibility of arming the Mark 5s with guided missiles is now being reconsidered.

As an attack on the United States might come over the polar regions and Canada, the Americans have more than a passing interest in Canada. Under the terms of an agreement made before Newfoundland joined Canada, U.S. Air Force Convair F-102 fighter squadrons are based in Newfoundland and at Goose Bay, Labrador. Permission has just been given for the construction in Northern Canada of four bases for Strategic Air Command tankers. The Americans have built and are operating the Distant Early Warning radar line, whose over 50 stations perch on hills overlooking the Arctic Ocean.

The second line of defence is the $235,000,000 Mid-Canada line, or McGill Fence, so named after the university which originated it. This is not radar, but a low-power transmitter and receiver working on the Doppler principle, and providing positive identification of aircraft flying between 50 ft. and over 100,000 ft. The line extends the 2,600 miles from coast to coast, roughly following the 55th Parallel.

Like the DEW line, its construction has been a story of hardship, for much of it lies in muskeg, and the builders had to overcome mud, slime, and black flies in the summer, and bitter cold in the winter. One proposed site on Hudson Bay was occupied by so many polar bears that work had to be suspended until the animals decided, in their own time, to move on. To withstand the rigours of the climate the antenna towers have to carry de-icing equipment. Again like the DEW line, the Mid-Canada line is largely manned by civilians.

Ground-controlled interception is in the hands of a third chain, the Pinetree line, built near the American border, and manned by both U.S.A.F. and R.C.A.F. personnel. A fourth warning system, extending down both flanks of the continent to prevent outflanking of the trans-continental networks by hostile aircraft, consists of radar picket ships and airborne early-warning Super Constellations.

Operations of the R.C.A.F. and the U.S.A.F. are integrated through the North American Air Defence Command (NORAD), with headquarters at Ent Air Force Base, Colorado Springs, Colo. Its commander is General Earle E. Partridge, U.S.A.F., while Air Marshal C. Roy Slemon, C.B., C.B.E., C.D., the former Chief of Air Staff, is his deputy. There has been close co-operation between the two nations for years, but a fully integrated command, responsible to the chiefs of staff of both countries, was not set up until August, 1957.

One would think that standardization of equipment would be a most desirable step, but Canada and Belgium are the only nations with CF-100s. American fighter squadrons are equipped with Genie atomic air-to-air missiles, while the CF-100s carry only rockets. Defence Minister G. R. Pearkes has said that Canada could have nuclear war-heads virtually for the asking—an optimistic view in the light of the U.S. law which restricts distribution of nuclear weapons outside the States.

Recently, Defence Minister Pearkes surprised the House of Commons Estimates Committee by stating that the $1,250,000,000 DEW line didn't have the range to detect the latest Russian bombers. The altitude range of the Pinetree line is also being increased.

With the CF-100 now obsolescent, the R.C.A.F.'s problem is now one of phasing in a new fighter or missiles or both. Heavy hopes are being pinned on Avro Canada's advanced 30-ton CF-105 Arrow, 37 of which have been ordered. The Government has until the end of the year to decide whether to order the Arrow into full-scale production. By March, 1959, $398,000,000 will have been spent on the Arrow programme, about half as much as the Air Force's entire current budget. Present estimates are that the aircraft will cost about $4,500,000 each, apart from expensive auxiliary equipment such as starters and readiness hangars, so that the cost of equipping all nine home defence squadrons would be about $1,000,000,000. Mr. Pearkes has said that not all the squadrons might get the Arrow; some might get missiles.

The extent and cost of the Arrow programme are so great that it limits participation in other defence measures. This is unfortunate, as it is most unlikely the U.S.A.F. will purchase Arrows, as had been hoped. The R.C.A.F. has nothing comparable to the U.S.A.F.'s Nike ground-to-air missiles, and is very interested in the Boeing IM-99 Bomarc.

There have been strong hints that Canada might have to invest in the billion-dollar Semi-Automatic Ground Environment (SAGE) control system, which would greatly increase the

Below, the Piasecki H-21A is the R.C.A.F.'s standard helicopter for search and rescue operations. H-21Bs were used extensively during the construction of the Mid-Canada line, and have now been leased to civilian operators.

Below, right, the R.C.A.F. uses de Havilland Canada Otters for search and rescue and communications work. In 1959, some will be assigned to some of the auxiliary air force squadrons for civil defence liaison and rescue.

Above, R.C.A.F. home defence squadrons are directed from NORAD headquarters at Colorado Springs, Colo. This CF-100 Mk. 5 was part of a detachment from Uplands, near Ottawa, visiting U.S.A.F. Convair F-102 squadrons in Newfoundland.

Right, the first Naval aircraft ever built in Canada for the R.C.N. is the Grumman CS2F-1 Tracker. Here is one, with arrester hook down, approaching H.M.C.S. "Bonaventure."

number of targets which could be handled by each radar station, and reduce interception times. Each SAGE section, one of which could cover Eastern Canada, would require two Bomarc squadrons of 120 missiles each. The Americans expect to have SAGE operational by 1962, a year after the CF-105 could be in squadron service, but Canada's decision on both SAGE and the Bomarc must await the outcome of the Arrow's tests. If these are unsuccessful, a fighter will be bought from elsewhere. The Convair F-106 would be the most likely contender. It has been argued that purchase of this aircraft would have been much wiser and more economical than building the Arrow in the first place, because of the strain the Arrow programme has put on the budget. Moreover, the total order for Arrows is unlikely to be for more than 200 aircraft, and probably for less, so that the unit cost must be high.

The success of the Arrow is tied in with the success of the Douglas Sparrow 2 missile. It is difficult to separate gen from gossip in this area, but apparently the U.S. Navy abandoned the Sparrow 2 as it would not have a fighter which would appear at the same time. Effort was then concentrated on the Sparrow 3, whose development schedule coincided with that of a new fighter. Consequently, the Sparrow 2 has involved rather more development work than Canada counted on, which may be one reason the CF-100 Mk.6 programme was cancelled.

Many of the airframe and accessory manufacturers sense a lack of planning in the Services' missile programmes. They fear that if missile orders are delayed too long, skilled people will have been laid off, and the Services may establish delivery schedules which will preclude the possibility of designing or producing them in Canada.

General Partridge has said that North America is naked to ICBM attack. Canada's Defence Research Board is working with the Americans on an ICBM detection system, with 1960 as the target date. Meanwhile, the existing radar lines are supplemented by 50,000 members of the civilian Ground Observer Corps.

Overseas, Canada has contributed a 6,000-man air division to N.A.T.O. under Air Marshal H. B. Godwin, C.B.E., C.D. There are two fighter Wings in Germany, at Zweibrucken and Baden-Soellingen; two in France, at Gros Tenquin and Marville; a logistics supply depot at Langar, England; an air-firing range in Sardinia, a radar squadron with NATO, and the division headquarters at Metz, France. Eight squadrons are equipped with Orenda-engined Sabre 6s, and four with CF-100 Mk.4s. The future of these units is uncertain, and it is not known whether they will be re-equipped with a fighter like the F-104 Starfighter, replaced by missiles, or merely up-dated by carrying guided missiles.

With the Russian submarine fleet now far larger than the German wartime fleet, anti-submarine aircraft are important to an exporting nation like Canada. Maritime Air Command (Air Commodore Martin Costello, C.B.E., C.O.), with headquarters at Halifax, is responsible for a squadron on the West Coast (at Comox) and two on the East Coast (Greenwood, N.S.) as well as for the Maritime O.T.U. at Summerside, P.E.I. The 50 aircraft on the East Coast are Canada's contribution to NATO's SACLANT. The two Eastern squadrons are now re-equipping with the Canadair CL-28 Argus, while their Neptunes are replacing the Lancaster MR.10s of the Comox squadron. This will not mean the end of the Lancaster, however, for some will remain for search and rescue or photography and two are being converted to carry Ryan Firebee drones.

With an endurance of 24 hours, provision for homing torpedoes, depth charges and sonobuoys, 21 radio and radar installations, and really spacious crew quarters, the Argus is perhaps the most advanced aircraft in its field. It has become popular with the crews in the short time since the first aircraft was accepted on May 17, 1958. Although developed from the Britannia, Canadair did much engineering work, all wing and tail structural drawings being re-drawn to American standards. About 50 aircraft are on order. Canadair had hoped to sell some to the United States, so that the U.S.N.'s order of a patrol version of the turboprop Electra was a severe blow.

Air Transport Command (Air Commodore F. S. Carpenter, A.F.C., C.D.) whose headquarters at Lachine, P.Q., near Montreal, are to be transferred to Trenton, Ont., next year, logs nearly 70,000 hours per year. Its operations extend from the Arctic to Indo-China to Europe. Long-range support is handled by 426 (T) Squadron at Dorval, P.Q., flying North Stars. No. 412 Squadron, at Uplands, near Ottawa, operates unscheduled flights for military personnel, Government leaders and international visitors. It flies a mixed bag of Dakotas, Mitchells, Expediters, Comet IXBs, and the Canadair C.5. The supply of the weather stations in the Arctic and the stations

A Fairchild C-119G Packet of the R.C.A.F. in an Arctic setting. Resupply of Canada's isolated weather stations and Arctic outposts is largely done by the two Packet Squadrons, 435 and 436, from Edmonton and Toronto.

Canadian Aviation Today . . . .

along the North-west Staging Route to Alaska, as well as para-dropping are the responsibility of two squadrons of Fairchild C-119 Packets, based at Namao, near Edmonton, and Downsview, near Toronto.

Moving any number of Army personnel is a strain on the Command's resources, and the biggest movement carried out was a drop of 500 paratroopers by 13 Packets. Nevertheless, the Command has almost as many large aircraft as the R.A.F. Its fleet is estimated at 20 North Stars, 33 Packets, 2 Comets and 5 Bristol Freighters, the last based at Langar to support No. 1 Air Division.

On order are eight Canadair CL-44s, a Tyne-engined version of the Britannia, and 10 Canadair 540s, Eland-engined turboprop versions of the Convair 440 Metropolitan. The R.C.A.F. wished to order 10 Viscounts, but the Government insisted on an aircraft that could be built in Canada because of the poor employment situation. No other orders for either type have been received. Even in the aircraft industry there has been strong criticism of the Government policy of tooling up to make such small numbers of aircraft; the break-even quantity for the CL-44 is probably 75 to 100 machines.

Also under Air Transport Command are 408 (Reconnaissance) Squadron, whose Lancasters do photographic and Shoran survey of the North, and a helicopter flight whose yeoman work in the construction of the Mid-Canada line resulted in the award of the McKee Trans-Canada Trophy to its commander, Sqn. Ldr. Robert T. Heaslip, A.F.C. In addition, the Command has an O.T.U. at Trenton, Ont.

Tactical Air Command (Group Captain H. G. Richards, O.B.E., C.D.) with headquarters at Edmonton, is responsible for tactical air support training and operations, together with the preparation of detailed plans for Canada's Mobile Striking Force. Apart from communications, transport and search aircraft, the Command has no operational squadrons assigned to it.

The R.C.A.F. co-ordinates search and rescue activities from coast-to-coast through rescue centres. In 1957, search and rescue Lancasters, Otters, Vertol H-21s and Dakotas, flew 8,200 hours.

After joining the R.C.A.F., aircrew candidates are given a 12-week course of instruction at the Pre-Flight School at Centralia, Ont. On graduating, those selected as observers are posted to the navigation school at Winnipeg, while potential pilots remain to learn *ab initio* on de Havilland Chipmunks. After six weeks, they transfer to Harvard-equipped flying training schools on the Prairies. Advanced flying schools in Manitoba train the students to wings standard in Canadian-built, Nene-engined Lockheed T-33 Silver Stars. Those destined for piston-engined aircraft go instead to Saskatoon, where they wrestle with Beechcraft Expediters and North American Mitchells. Training Command (Air Vice-Marshal J. G. Bryans, C.B.E., C.D.) headquarters in Trenton will be moved to Winnipeg next year.

For several years the R.C.A.F. has been evaluating jet basic trainers, among them the Hunting Percival Jet Provost, the Cessna T-37, and the Morane Saulnier MS.760 Paris. A decision has been delayed, and the most likely candidate is the Canadair CL-41, now being built in Montreal.

More than 5,000 pilots and observers from 10 NATO nations have been trained by the R.C.A.F. since late 1950. Training for aircrew from Britain and six other countries stopped in 1957, although 360 pilots from West Germany began training in the same year. The R.C.A.F.'s own trainees come mainly from young men with junior matriculation, although the universities and the three Canadian Services' Colleges provide some candidates. At present, the R.C.A.F. has 9,598 officers and 41,327 airmen and airwomen.

The Air Material Command's (Air Vice-Marshal C. L. Annis, O.B.E., C.D.) duties are unromantic but important, there being 29 units ranging from explosives' depots to construction and maintenance units. One of the most important units is the Central Experimental and Proving Establishment at Uplands, near Ottawa. Its Climatic Detachment at Namao, near Edmonton, does cold-weather testing of aircraft and equipment, and is much used by Britain's Ministry of Supply. A detachment at Cold Lake, Alta., undertakes armament trials, and has recently been testing the underslung rocket pods on the Argus.

The Auxiliary Air Force has 11 flying squadrons, apart from numerous medical, technical training, radar and other units. Five squadrons are equipped with Beechcraft Expediters, while six others—two each at Toronto, Montreal and Vancouver—fly Sabres and Lockheed T-33s. The fighter squadrons, which re-equipped from Vampires only in the Fall of 1956 and did not have time to become operational, will begin to convert this September to an emergency and rescue rôle. In case of an atomic attack, it is thought they could aid civil defence forces.

This theory is in striking contrast to that in the United States, where Air National Guard squadrons fly such up-to-date and complex types as F-89 Scorpions and RF-84F Thunderflashes. Initially, the R.C.A.F. squadrons will be equipped with six Expediters, and ultimately one squadron at each point will have four Expediters and four Otters, while the other has four Expediters and four Bell 47 helicopters. The present strength of the Auxiliary is 1,818 officers and 2,809 airmen and airwomen.

The Chief of the Air Staff, Air Marshal Hugh L. Campbell, C.B.E., C.B., LL.D., has at his disposal 1,883 aircraft, of which 808 are operational fighters, transports or logistic support. About 900 are allotted to training, another 63 are under test, and 112 are on miscellaneous duties such as communications and search and rescue. There are four types of jet aircraft, four types of helicopters, and 14 piston-engined fixed-wing types. Indicative of the strong support given the aircraft industry in Canada is the fact that 11 of these types were built in Canada.

Naval Aviation in Canada

Naval aviation is an integral component of the Royal Canadian Navy in its rôle as a force specializing in anti-submarine operations. The importance of the R.C.N.'s task, and the weight of its responsibilities, have been appreciably increased by the development of the long-range submarine and its potential as a mobile, hidden platform able to launch missiles aimed at vital targets far from the sea.

Having returned the aircraft carrier "Magnificent" to the Royal Navy, the R.C.N. now has a new light fleet carrier, "Bonaventure," built in Britain and commissioned in early 1957. She has an angled deck, steam catapult and mirror landing aid. One squadron of fighters, another of anti-submarine aircraft and a few helicopters are normally carried.

The anti-submarine aircraft are Grumman CS2F-1 Trackers, built by de Havilland Aircraft of Canada, at Downsview, near Toronto. This is the first naval aircraft ever built in Canada for the R.C.N. The Tracker carries a crew of four, consisting of a pilot, co-pilot, radar-sonobuoy operator and magnetic-anomaly/counter-measure operator.

Squadron HS-50 is experimenting with Sikorsky HO4S-3 helicopters with "dunking sonar." Extensive and promising trials have been carried out both from "Bonaventure" and from frigates and destroyer-escorts fitted with landing platforms. One wonders how a frail helicopter, however securely lashed, would stand up to North Atlantic storms and winter ice.

Fighter cover is supplied by F2H-3 Banshees, purchased from the U.S. Navy. These are described as "all-weather fighters," but reporters still recall the Banshee demonstration which was called off because of weather. Some Banshees have already been fitted with Sidewinder infra-red homing missiles, and the remainder are being equipped as soon as possible, with priority being given to the two operational squadrons, VF870 and VF871. Thus the Navy has an operational air-to-air missile before the R.C.A.F.

Training is carried out at H.M.C.S. "Shearwater," the naval air station at Dartmouth, N.S., in Harvard 2s, Lockheed T-33 Silver Stars and Beechcraft Expediter 3s. Bell HTL and Piasecki HUP helicopters are also in service. Aircraft early warning is handled by a few Avengers with "Guppy" radar.

Today the R.C.N. has almost 150 operational aircraft. There are four front-line squadrons, two being equipped with Trackers and two with Banshees. The other six regular-force squadrons are responsible for communications (utility duties in the parlance borrowed from the U.S. Navy), plane-guard duties, training and experimental work. With the exception of utility squadron VU-33 at Patricia Bay, B.C., all the Regular-Force squadrons operate either from "Bonaventure" or the single naval air station. Reserve squadrons, mainly equipped with Harvards, are located at Toronto, Kingston (Ont.), Calgary (Alta.), Quebec City and Victoria (B.C.).

Air personnel engaged in the operation, maintenance and support of the regular squadrons number over 350 officers and 1,700 men. Their enthusiasm and *esprit de corps* have done much to overcome the disadvantages of the cast-off aircraft and lack of funds which have characterized the early growth of the service.

The Canadian Army has about two dozen Cessna L-19A and L-19B Bird Dogs for artillery spotting and liaison, as well as a few helicopters. Training is carried out with the other Services at the Canadian Joint Air Training Centre at Rivers, Man. With the increasing emphasis on mobility, many Army officers want to become independent of Air Force transport. The Army has supported the development of the de Havilland DHC.4 Caribou transport, and if it is successful an order is most likely. It is probable that the Army will simultaneously purchase some transport helicopters.

Whatever the future holds, Canada's Services have shown a willingness to improvise and to develop original equipment and plans suited to their peculiar problems. Such initiative should continue to stand them in good stead in the difficult days ahead.

Canadian Aviation Today . . . .

Canada's Aircraft Industry

by F. G. Swanborough

DURING the present year, Canada's aircraft manufacturers are at work on more than a dozen distinctly different types of aeroplane. Although two of these are not at present in production status and the production of two others is likely to be complete by the end of the year, this is indicative of the effort which has been made, with considerable success, to broaden the industry's ability to meet both domestic and international requirements for aircraft of all types. In fact, so great a variety of aircraft has never before, we believe, been tackled simultaneously in Canada.

Running quickly down the list, the current types comprise the CF-100 and CF-105 all-weather fighters; the Avro WS606A research project; the Canadair CL-41 and T-33 Silver Star jet trainers; the CL-28 Argus maritime reconnaissance type; the CL-44 and Canadair 540 turboprop transports; the Sabre 6 interceptor; the CS2F-1 Tracker anti-submarine type; the Beaver and Otter utility and bush aircraft; and the Caribou utility transport. So there is a wide variety of aircraft available—in several cases these types being, if not actually unique, at least in a class which has received little attention in other countries. In order to maintain the aircraft industry at its present healthy level, however, it is becoming increasingly important that Canada exports her aeronautical products; the requirements of the Canadian services and civil operators alone certainly could not support for long a dozen different types at even a modest production rate.

Some export success has already been achieved with the Sabre, CF-100, Beaver and Otter. The WS606A project is entirely supported by United States funds and the Caribou, CL-41, CL-44 and Canadair 540 all have good prospects of overseas sales. So also, has the Iroquois turbojet which is now the most important aero-engine in production in Canada and for which a leading American manufacturer has already reserved a licence. Two other turbojets—the Orenda and Nene—are still in production in addition to one or two older types of piston engine.

In the missile field, Canadian progress has been slow, very largely as a result of uncertainties over official requirements. The prime airframe manufacturers now have several years of research and development work behind them and one missile—the American-designed Sparrow—will reach the production stage next year.

The ancillary industry, which has grown quite rapidly in recent years, continues to be tied closely—a little too closely, perhaps, for its own comfort—to Canada's own aircraft output. Although much of the equipment produced is of a very high standard, in a competitive market this equipment cannot easily be sold outside Canada. Consequently, production runs tend to be small and prices high, and a reduction in the numbers of aircraft built annually in Canada could have serious repercussions in certain sections of the industry.

On pages 270 and 271 of this issue, we have listed those companies which are most directly involved in the manufacture of aircraft, aero engines and accessories in Canada. The work of the major units of the industry is described in rather more detail in the remainder of this article and details of the newest aircraft are on pages 265 to 269.

AVRO CANADA, LTD.

As the principal Canadian unit of the Hawker Siddeley Group, Avro Canada, Ltd., is now the parent company of all the Group subsidiaries in Canada. These at present total over 40, most of which are not concerned with the aviation business. In fact, the Hawker Siddeley Group's recent policy of broadening the base of its activities has been actively pursued in Canada with the result that Avro Canada now controls or has an interest in such companies as Canadian Steel Foundries, Canadian Steel Wheel, Applied Research, Ltd., Vivian Diesels and Canadian Thermo Control. Through the Dominion Steel and Coal Corporation, Ltd., the group acquired an interest in a further 32 companies, and the expansion is continuing.

The principal aircraft companies are, of course, Avro Aircraft for the design and production of aircraft, Orenda Engines for the development of engines, and Canadian Car Co. and Canadian Steel Improvement in the ancillary field.

Last month, Mr. Crawford Gordon, O.B.E., was appointed to the board of the Hawker Siddeley Group—a step which further underlined the importance attached by the Group to Canadian affairs. Avro Canada companies now employ a total of more than 20,000 people; latest available figures show a combined sales figure of $235 million and an operating profit of $24 million.

Avro Aircraft, in the past year, have moved into the flight-test stage with the significant CF-105 Arrow all-weather fighter, which is among the most advanced aircraft of its kind in the World (see page 265). Firm and prospective orders for the Arrow at present are for a total of rather less than 40 aircraft but additional orders will certainly be placed if the aircraft's promise, shown in early test flights, is confirmed as experience builds up. Investment in the project to date plus the cost of producing the first 35-40 aircraft has been put at some $400 million, and at least 600 Canadian companies are involved, to a greater or lesser extent, in the programme.

As the Arrow production mounts, the CF-100 is being phased

Although the missile-equipped CF-100 Mk. 6 with afterburners has been abandoned after one prototype was flown, Avro Aircraft have completed several Mk. 5Ms for development flying with the Canadair Sparrow II missile. One of these Mk. 5Ms is seen here carrying four dummy missile rounds.

out, and will terminate around the end of this year with about 700 built. The proposal to build a Mk. 6 variant, with missile armament and after-burning Orenda engines, was abandoned after one prototype was completed last year, but several Mk. 5Ms have been produced by Avro for missile development purposes. These carry four Canadair Sparrow missiles each.

Sometime next year—probably in the second quarter—Avro is expected to roll out the prototype of Project Y, identified by the United States Air Force Weapons System designation WS606A. This radical concept, with its "horse-shoe" wing geometry, was conceived by Avro back in 1951, and the U.S.A.F. acquired a complete interest in it three years ago. Since that time, it has been the subject of some of the strictest—and most effective—security regulations ever applied to an aircraft project.

Suffice to say here that whereas the first application is intended for high speeds, other Services are interested in other applications of the principle for lower speeds, and Avro may have in the WS606A the beginnings of a highly profitable line of business in years to come. The first research model makes use of British turbojets.

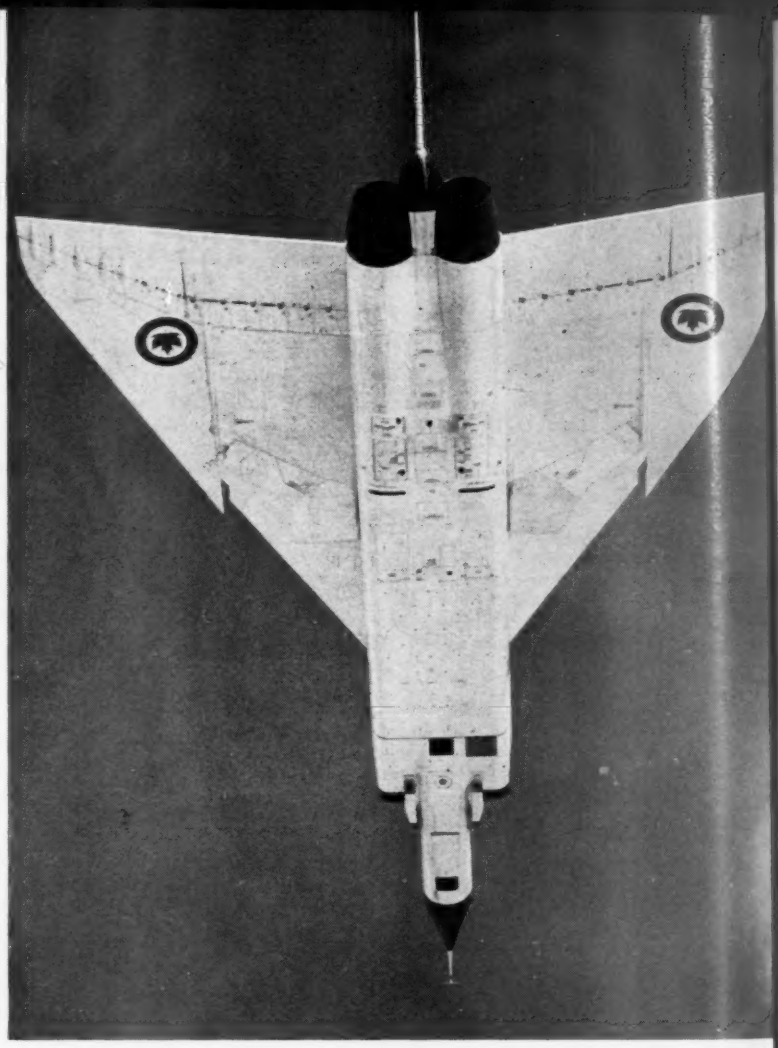
Avro employment has now levelled off around the 9,000 mark after some recent fluctuations above and below that figure. The company's headquarters at Malton, outside Toronto, have a total floor area of 1,685,000 sq. ft.

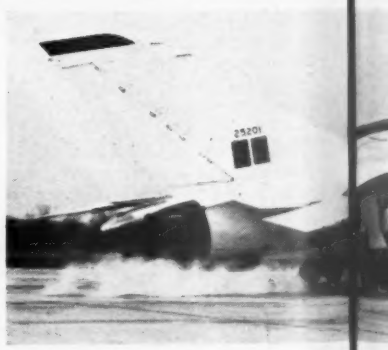
Orenda Engines, Ltd., have now amassed over 5,000 hours' ground and air-running time on the Iroquois, which is perhaps the most powerful engine to have reached this stage of development. Flight development is still limited to the special B-47 Stratojet which Canadair converted last year, and the company has been having some difficulty in finding ground test facilities equal to the Iroquois' performance. In the highly successful tests made in the N.A.C.A. high-altitude test chamber at the Lewis Laboratories, in Cleveland, earlier this year, the Iroquois was tested to the limit of the chamber, at speeds above Mach 2. The company's own high-altitude test facilities at Malton have just been completed and after being proved out by an Orenda will be used for Iroquois development beginning later this year.

About 4,200 Orendas have been built to date for Sabres and CF-100s, but production is now tapering off, the original three assembly lines having been reduced to one. Overhauls for the R.C.A.F. are still a steady line of business on the Orenda 8 (CF-100 Mk. 3), 10 (Sabre 5), 11 (CF-100 Mk. 4 and 5) and 14 (Sabre 6), and there is a possibility that the R.C.A.F. will adopt a plan to convert old Orenda 8s to 17s by adding an extra compressor stage. Another possible outlet for further Orenda production is in the projected Sabre 7.

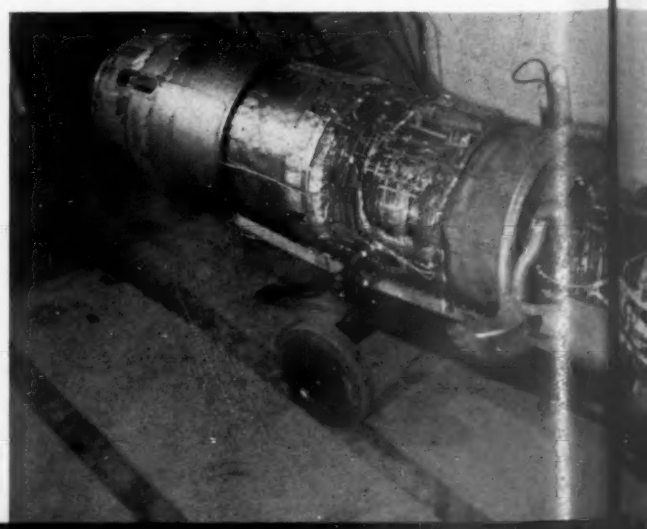
Nevertheless, Orenda Engines face the possibility of a run down in employment from the present level of 5,000 while Iroquois production gets into full swing. For this reason, consideration is being given to many other facets of power production, ranging from auxiliary generators and turbine air starters, through small (750 h.p.) power turbines and industrial turbines to nuclear power. Orenda Industrial, Ltd., was formed on May 1 to further the study of industrial application of gas turbines, with an associated company in New York.

Canadian Car Company, Ltd., acquired by Avro in 1957, has not produced complete aeroplanes since completing contracts for the Harvard 4 and the Beech T-34 Mentor. Facilities exist, however, for the production of small aircraft types and the earlier liaison with Beech could possibly lead to other developments in this direction. Meanwhile the company is occupied primarily as a sub-contractor to de Havilland on the CS2F-1 and Otter, and in the production of Harvard spares, for which it holds an exclusive World-wide licence outside of the U.S.A.





Avro's Arrow is the most important aeroplane at present in production in Canada. Although its future has still not been defined by the Government, more than $200 million has been spent to date and Avro are confident that substantial production orders will follow.



Canadian Aviation Today . . . .

BRISTOL AEROPLANE CO. OF CANADA (1956), LTD.

Although not directly involved in aircraft production, the Bristol group of companies occupies an important position in Canada. From Montreal, the holding company—a wholly-owned subsidiary of Bristol in England—controls the various Canadian working companies, in addition to the recently-created branch in Mexico City. Together, the Canadian companies employ some 2,000.

Bristol Aircraft (Western), Ltd., is the largest of the Canadian companies in the group and was originally MacDonald Bros. Aircraft. Since its acquisition, it has been extensively developed and now has two major departments, for the manufacture of aircraft sub-assemblies and for general overhaul and modification. These are primarily engaged in the production of Otter and CS2F-1 components and the overhaul of various types of aircraft in service with the R.C.A.F.

Bristol Aero Engines, Ltd. This Montreal branch was the original Canadian Wright company before its acquisition by Bristol, and it continues to be primarily concerned with engine overhauls. This work is undertaken on radial and in-line piston engines of all types in service with the R.C.A.F. and civil operators, the most important line of business being the overhaul and reconditioning of Wright Turbo-Compounds for T.C.A. Super Constellations and the R.C.A.F. Packets and Neptunes.

Earlier this year, Bristol Aero Engines formed an aviation services division at Montreal Airport. This division is concerned with aircraft ramp handling and maintenance and is initially handling the services of C.P.A. at Montreal.

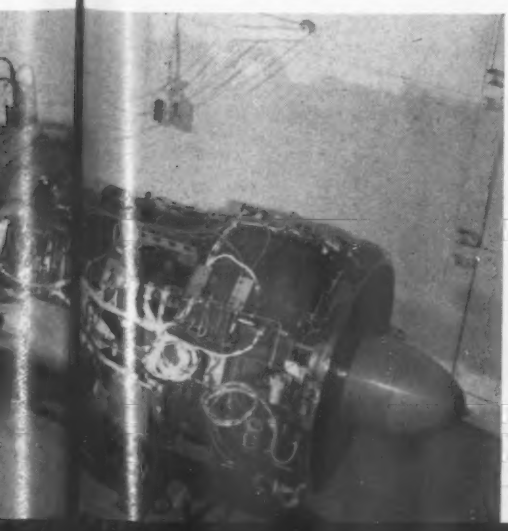
Bristol Aero Engines (Western), Ltd., have added to their facilities at Vancouver suitable equipment for the overhaul and testing of the Proteus turboprop, and are now working on these engines for Aeronaves and C.P.A. About 12 engines a month are being worked on, this being additional to the overhaul of R-1820 and R-2600 radials for the R.C.A.F. and civil users, which has been a "bread-and-butter" line for several years. The Proteus work has required the construction of a new test cell, which was formally opened by Mr. Grant McConachie on February 22 this year.

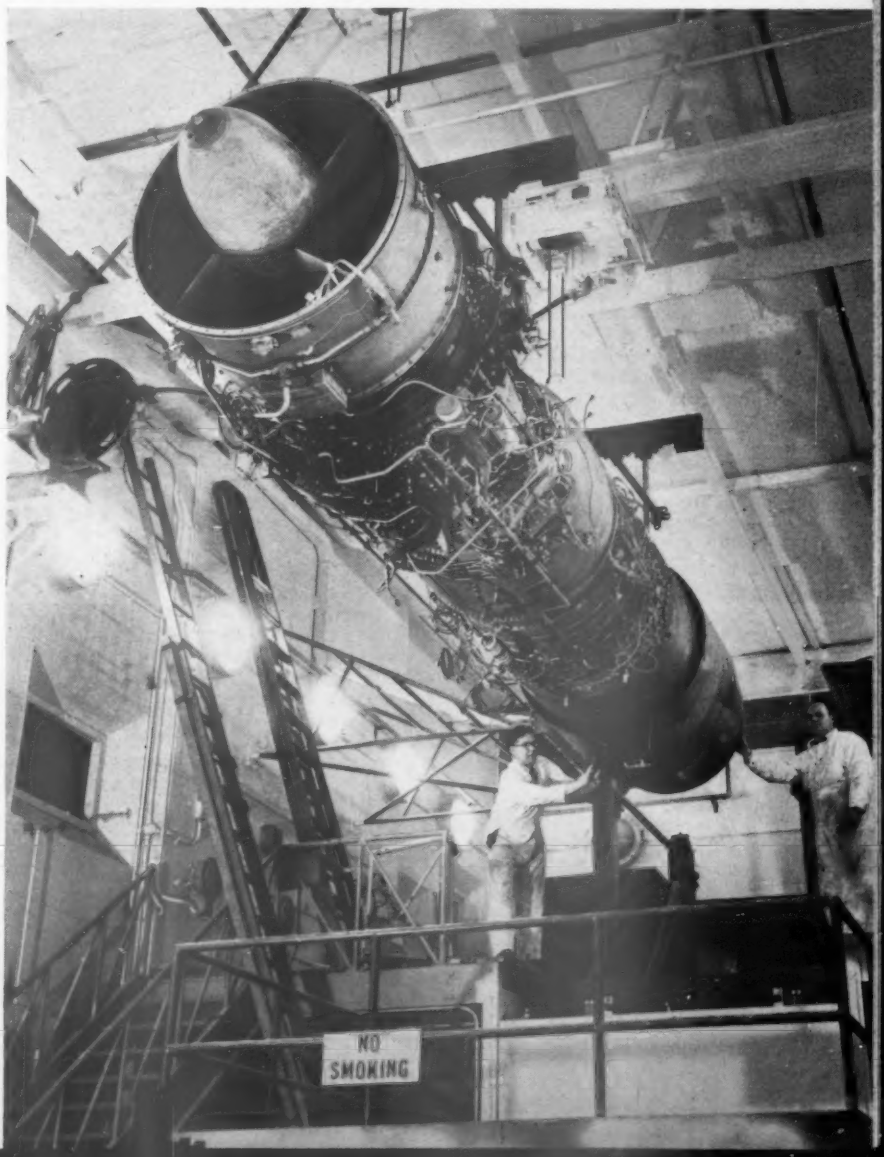
CANADAIR, LTD.

In the past year, there have been several important developments at Canadair which have served to strengthen the company's position considerably. These include the decision to put into production the Eland-engined Convair, now known as the Canadair 540 and backed by an R.C.A.F. order; the bid for an R.C.A.F. jet trainer order by construction of prototypes of the CL-41 on a P.V. basis, and further progress with the Sparrow II missile.

Canadair actually have six types currently in hand. Of these, the oldest is now the Sabre. Production of the 225 Sabre 6s for Germany will end late this year and this will conclude Sabre production unless further orders are received by then. A Sabre 7 has been projected, to have an afterburning version

Matched with the Arrow is Orenda's powerful Iroquois turbojet, which is capable of development as a Mach 3 engine. To fly in the Arrow 2 next year, the Iroquois has an integral afterburner and will be rated initially at more than 20,000 lb. dry.





Canadian Aviation Today . . . .

of the Orenda and be armed by two Sparrow II missiles, and this is arousing some interest outside Canada.

The T-33A-N Silver Star also continues in production at a very slow rate (two to three a month) intended simply to match the attrition rate on this type in service with the R.C.A.F.

At present, the major production effort at Cartierville is going into the CL-28 Argus, Canadair's Britannia derivative for maritime reconnaissance (see page 268). About a dozen of these have now flown and the first squadron was formed at Greenwood earlier this year. The first two orders, which totalled 25 aircraft, have now been supplemented by a third, smaller, contract, and the company still hopes to sell this type abroad.

Making use of some Argus components, the CL-44D transport is one of the types with which Canadair hope to get back into the commercial market (see page 267). Since eight CL-44s were first ordered by the R.C.A.F. early in 1957, quite a lot of re-design has been necessary to replace the Orion engines with Tynes. This work is now complete and the first CL-44 is expected to fly on schedule towards the end of next year.

Under the terms of their agreement with Bristol, Canadair will be able to sell the CL-44 in military or civil guise in almost any part of the World. It is intended that the CL-44 should be offered in three forms for commercial use—as the Canadair Liner, the Canadair Freighter and the Canadair Freightliner. A new assembly line for the CL-44 is in process of being established, the major fuselage assembly jigs now being complete.

Like the CL-44, the Canadair 540 is going into production for the R.C.A.F. but will, it is hoped, be sold commercially also. The purchase of these aircraft by the R.C.A.F. is a particularly good example, incidentally, of the way in which the Canadian industry is helped by the Government policy of buying at home. The R.C.A.F. requirement could, in fact, have been met more quickly and perhaps more satisfactorily by the purchase of aircraft already in production overseas; and in fact a contract for Viscounts was almost signed before the Canadair plan was adopted.

Canadair have purchased Convair jigs and tools for the Metropolitan for a nominal sum, and are now installing these at their Montreal factory. The final assembly line will take the place of the Sabre line and the first Canadair 540 is scheduled to fly next spring (see page 268).

Sixth aircraft in the Canadair stable is the CL-41 trainer (see page 266). This is of some significance, as it is the first aircraft of wholly original Canadair design to be built, and the first project the company has undertaken at its own expense. Two prototypes are under construction with the hope that the R.C.A.F. will soon make up its mind on the question of primary jet training and will place a production order.

In the missile field, Canadair is strongly placed as a result of its contract to produce the Sparrow II air-to-air missile for the R.C.A.F. This is to be the primary armament of the Arrow, and, as noted above, might be used also on a version of the Sabre.

The company's missile activity is in process of becoming a separate division, and is still being expanded. To date, the company has produced some aerodynamic test rounds for use on the CF-100 Mk.5Ms, and has received some production Sparrows from Douglas for familiarization. The first complete Canadian rounds are expected towards the end of the year.

Despite the full aircraft and missile programme, the company is also at work in other fields, including nuclear reactor development. For the Canadian Army, the CL-61 Rat "snowmobile" holds great promise.

CANADIAN PRATT & WHITNEY AIRCRAFT CO., LTD.

This company—the representative in Canada of the United Aircraft Corporation—continues to grow in activity and employment. In production are the R-1340 Wasp, of which the company is now the sole source, and the R-1820—which power, respectively, the Otter and CS2F-1. Spares for these engines and for the R-985 and R-2000 are supplied by C.P.W. throughout the World, on behalf of the parent company, and this is in fact the most remunerative of the company's activities.

Repair and overhaul of Pratt & Whitney engines are also undertaken, and for the Caribou the company has contracted to recondition R-2000s.

As a result of its latest extensions, Canadian Pratt & Whitney now occupy some 700,000 sq. ft. of floor space and total employment is substantially above 3,000.

DE HAVILLAND AIRCRAFT OF CANADA, LTD.

The Caribou is now the most important "de Hav" project in Canada, but this is not to say that the Beaver and Otter are waning in popularity. Both continue in production at a fluctuating rate to match demand, and re-orders from the U.S. Army and Air Force provide a steady source of work. At the beginning of May, de Havilland had built 1,212 Beavers, of which 796 were for the U.S. forces; and 243 Otters including 133 for the U.S. and Canadian services.

By the time these words are read, the Caribou (see page 269) should be progressing with its flight trials. This is the first of seven which the company is building expeditiously, five for the U.S. Army and two for the Canadian Government. These are a pre-production batch, but they are being jig-built for the most part on production jigs.

Some difficulty has been experienced in finding adequate floor space for manufacturing and assembly operations on the Caribou, which at present are rubbing shoulders with Beavers and Otters—and some CS2F-1 component production—in Plant I. If large orders for the Caribou follow, as the company hopes, alternative plans may need to be made for the Beaver and Otter.

The final assembly line for the CS2F-1 Trackers for the R.C.N. is across the field in Plant II, where rather more than two-thirds of the first contract for 60 aircraft has been completed. A further contract has been awarded and production at the rate of two a month should continue into 1960. De Havilland's are the prime contractor for the CS2F-1, but actually produce only the forward fuselage and flight deck so far as hardware is concerned, the remainder being sub-contracted in the Canadian industry.

Plant II also houses de Havilland's guided missile section, a department about which little is said publicly. The work began in 1952, being based originally on the parent company's efforts at Hatfield. It is now largely concerned with research and development on equipment and components.

Since the addition of a third storey, in 1957, to the office building at Plant I to house the main engineering office engaged on the Caribou, the Downsview plant has not been extended. Employment now runs at some 4,000 and is steady.

THE FAIREY AVIATION CO. OF CANADA, LTD.

On both the east and west coasts of Canada, the Fairey company maintains flourishing establishments for the overhaul, servicing and modification of R.C.A.F. and R.C.N. aircraft. The amount of work of this kind available to the company has continued to grow and the increasing complexity of modern aircraft has called for additional specialized departments to be formed, particularly to look after electrical and electronic equipment.

The other most important of the company's activities is the production of Fairey Hydroboosters, to the designs of the parent company, and hydraulic and pneumatic equipment in general.

ROLLS-ROYCE OF CANADA, LTD.

April 12, 1958, was a significant date for this company, for it was on that day that the first Dart turboprop overhauled by Rolls-Royce in Canada was returned into service. This was an engine from a Cubana Viscount, sent to Montreal for overhaul at the 1,500 hr. mark. Dart overhauls—for which special facilities including a new test cell have been installed—are now becoming an important activity, and will increase still further as the Fairchild F-27 and, later, the Grumman Gulfstream, get into service.

Rolls-Royce expect, in due course, to be called upon to overhaul Tynes from the CL-44s and the use of Conway engines in DC-8s and Boeing 707s to be operated by North and South American airlines is not without significance to this company. The older lines of business, overhauling Nenes from the R.C.A.F. T33s and Westinghouse J34s from the R.N. Banshees and R.C.A.F. Neptunes continue steadily.

The Montreal plant is a key unit in the World-wide spares supply system for Rolls-Royce aero-engines, and the company's sales staff also play an important part in the overall sales effort in North America on the various Rolls-Royce engines.

Canadian Aviation Today . . . .

The Avro Arrow

DEVELOPMENT of the Arrow supersonic all-weather fighter and its associated powerplant, missile and electronic equipment, represents one of the most extensive weapon system programmes ever undertaken outside of the U.S.A. Including the production of an initial batch of 35-40 aircraft, the programme to date is reported to have cost some $400 million, and it is unlikely that production Arrows on later contracts can cost less than $2 million each.

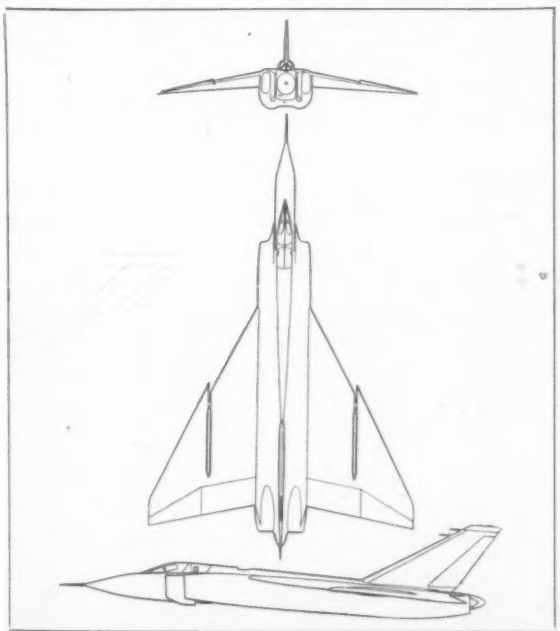
Although the more intimate details of the Arrow's structure, equipment and performance are, naturally, classified, the story of the design's evolution—from proposal to product in four years—can be told in some detail. The story begins in September, 1951, when the Avro company in Canada submitted to the R.C.A.F. design proposals for an advanced supersonic fighter; actual work on the project design had, of course, begun some months before this date.

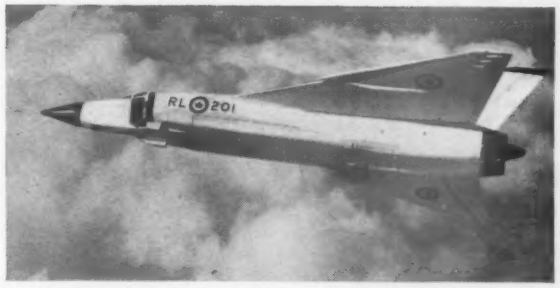
One of the three proposals was for a delta-wing all-weather fighter powered by two Armstrong Siddeley Sapphire A.S.Sa.4 turbojets. The Avro proposals were countered, in March, 1952, by an R.C.A.F. operational requirement for an all-weather interceptor, internally armed and capable of intercepting and destroying supersonic bombers at very high altitudes.

Avro chose the delta planform to meet this requirement, and then made extensive studies of both single- and twin-engined versions, the latter being preferred because it doubled the thrust without doubling the frontal area. Avro proposals were submitted to the R.C.A.F. in June, 1952, and were designated C104/1 for the single-engined type and C104/2 for the twin, both being two-seat deltas with internal missile bays and electronic fire control. Engines then under consideration were the Curtiss-Wright J67, Bristol Olympus B.Ol.3, and Avro TR9.

After the design had been examined by the National Aeronautical Establishment, the C104/2 was selected for further development, with a view to reducing the weight and meeting revised R.C.A.F. specifications. A new proposal along these lines was submitted by Avro in June, 1953, known as the C105, and a contract for a design study on this type was awarded a month later.

Work was immediately intensified, and the first wind-tunnel models were ready by September, 1953. At this time the Rolls-Royce RB106, then in an advanced stage of development, was chosen as the powerplant. The wind-tunnel tests which then began were part of an extensive programme covering performance from low speeds up to twice the speed of sound. Seventeen models, from 1/80th to ¼th scale, have been used at the N.A.E., Ottawa, the Cornell Aeronautical Laboratory, Buffalo, the N.A.C.A., Langley Field, and the N.A.C.A. Lewis Laboratory, Cleveland. In addition, 11 free-flight models were fired by rockets between December, 1954, and January, 1957.





The CF-105 designation was adopted during 1954, and towards the end of that year a major change in the programme became necessary when it became clear that the RB106 would not be ready in time, and perhaps not at all. The Curtiss-Wright J67 (Olympus) was adopted instead, but this also faded from the picture early in 1955, and the PS-13 Iroquois was then selected for the Arrow, with the first few aircraft to have Pratt & Whitney J75s as an interim measure. These engines distinguish the Arrow 1 (J75) and Arrow 2 (Iroquois).

Although the initial contract for Arrows covered less than a dozen aircraft, the American practice of tooling for production from the outset was adopted, and the jigs were proved-out in the production of a metal mock-up. Additional mock-ups include one of the front cockpit mounted on a truck to simulate the actual height and attitude during ground manœuvring.

The basic geometry of the Arrow is shown in the accompanying illustrations. It is based on the delta-wing with a leading-edge sweep-back of 63° 50′ and a thickness-chord ratio of the order of 4%. The leading-edge incorporates progressive droop from root to tip, and a "dog tooth" to improve the flow over the outer panels; "saw-cuts" are used rather than fences, to preserve chord-wise flow.

Structure is in keeping with the advanced concept of the aircraft, and includes many integrally machined panels and structural members. To turn out the massive integrally stiffened wing panels, a Kearney and Trecker skin miller has been installed. A typical wing skin handled on this machine is reduced from a 3,300-lb. light-alloy slab to a 290-lb. finished skin. The wing is a multi-spar structure with closely spaced ribs with an integral fuel tank in the centre wing behind the main undercarriage bay.

The fuselage, in essence a rectangular box, houses the two engines side-by-side at the rear, a very large missile bay in the forward lower fuselage, the cockpit between the intake ducts, and a nose radar installation. Much use is made of magnesium in the Arrow structure, and also of bonded-metal honeycomb in the less highly stressed areas.

Arrow equipment—there are at least 600 major suppliers in the programme—includes the very impressive Dowty main undercarriage and Jarry nosewheel leg; Dunlop wheels and tyres; AiResearch air-conditioning, and Martin-Baker Mk. 4 ejector seats. The armament comprises Canadair Sparrow II AAMs, and under development is the advanced Astra I electronic weapon system combining search, automatic fire control, navigation and communication. Collaborating in this development are RCA Victor (Montreal), Honeywell Controls (Toronto) and Computing Devices of Canada (Ottawa).

The first Arrow 1 was rolled out on October 4, 1957, and after a rather lengthy period of pre-flight checks during which several minor snags were overcome, the first flight was made by Jan Zurakowski, chief development pilot, on March 25, 1958. This flight lasted 35 minutes and was followed by eight others in the initial 10-hours period of tests, completed early in May. On the seventh flight, 1,000 m.p.h. was exceeded in level flight.

The second Arrow made its first flight on August 1, and three more Mk. 1s should be completed this year. There will then be a slight pause, with the first Mk. 2 due in the first half of 1959, and production then will build up rapidly.

AVRO ARROW DATA

Powerplant: (Arrow 1). Two Pratt & Whitney J75 turbojets with afterburners. Full augmented thrust at take-off, each, approx. 24,000 lb. s.t. (Arrow 2). Two Orenda Iroquois turbojets with integral afterburners. Full augmented thrust at take-off, each, in excess of 25,000 lb. s.t.

Dimensions: Span: 50 ft. Overall length, 77 ft. 9¼ in. Overall height: 21 ft. 3 in. Undercarriage track: 25 ft. 5.66 in.; wheelbase: 30 ft. 1 in.

Weights: Data not revealed. Max. operating weight in excess of 70,000 lb.

Performance: Data not revealed. Max. speed (Mk. 2) estimated in region of Mach=2.5. Service ceiling in excess of 70,000 ft.

Canadian Aviation Today . . . .

The Canadair CL-41

PROTOTYPES of the Canadair CL-41 jet trainer are now under construction at Cartierville, and are expected to fly next year. More than usual interest attaches to this design, for it is the first entirely original product of the Canadair drawing office to be built, and the first project which the company has undertaken wholly as a private venture. Hitherto, all Canadair products have been either adaptations of foreign designs, like the North Star, Argus, CL-44 and Canadair 540, or foreign types built under direct licence, like the Sabre and T-33.

The "raison d'être" of the CL-41 has been given by Canadair in the following words: "From observation of the experiments undertaken in the R.A.F. and U.S.A.F. with jet training methods, it has become apparent that the only truly efficient and economical means of leading the student from his first flight to the final stages of training is by the use of a single aircraft type instead of the two or three types which have been customary in the past.

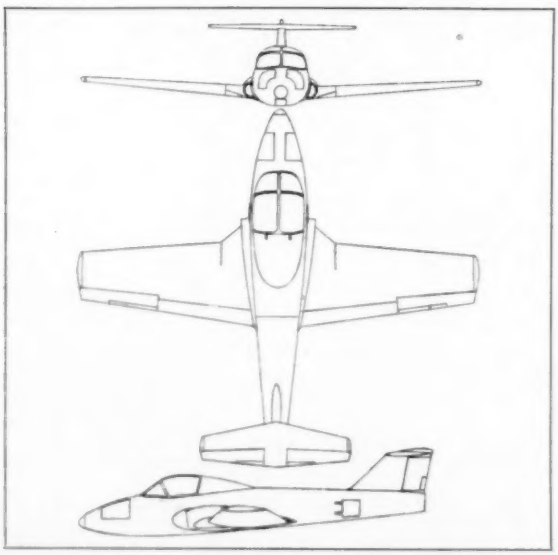
"After an exhaustive study of trainer aircraft available and projected, Canadair was convinced that no existing training aircraft had the characteristics or performance flexible enough to meet this challenging requirement. Canadair therefore decided to design and produce an entirely new basic pilot trainer, the CL-41, which will take the student to the point where he is ready for the supersonic trainer in the fighter role, or the multi-engined trainer in bomber, transport and maritime roles."

There is, at present, no clear indication of R.C.A.F. policy towards a basic jet trainer, although several such types have been evaluated, including the Hunting Jet Provost, some American types and the CL-41. Canadair certainly hope, however, to sell their trainer to the R.C.A.F. and the possibility of doing so must certainly have been a major factor in the decision to proceed with prototype construction.

As the illustrations here show, the CL-41 is a straightforward design, featuring side-by-side seating, wing root intakes for the engine and the tailplane mounted high on the fin to be clear of the disturbed air behind the canopy. Characteristic of the training role is the wide undercarriage track and wheelbase for safe taxi-ing, and the use of a single fuel tank, in the fuselage close to the centre of gravity, to help provide quick and positive recovery from the spin.

The CL-41 has a 1,500-p.s.i. hydraulic system and conventional 24-volt DC electrics. The control system is a simple push-pull tube type with no power boost, and air brakes are fitted on each side of the rear fuselage. For ease of maintenance, hinged doors at waist level give access to equipment in the nose compartment, where the hydraulic and electric accessories are grouped.

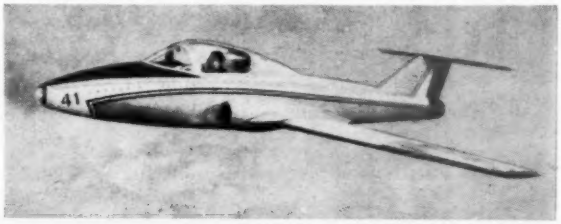
An unpressurized tunnel runs along the underside of the fuselage on the centre line and has large doors giving access to the flying controls, hydraulic piping and wiring runs. Access to the engine bay is gained by hinged doors on the underside of the fuselage aft of the wing main spar.



Canadair have chosen the 2,000-lb.s.t. Fairchild J83-R-1 turbojet to power the CL-41 in its prototype form, but have specified the General Electric J85, Pratt & Whitney JT-12 or Armstrong Siddeley Viper as alternatives.

In the pressurized cockpit, student's and instructor's panels are identical. Pressurization of the cockpit is by means of a "bootstrap" compressor turbine unit in the aft section of the nose-wheel well, taking air from the engine compressor. A cabin differential of 3 p.s.i. is sufficient for operations up to 38,000 ft. with the occupants using oxygen. Ejection seats, independently operated, are provided for both occupants; ejections can be made through the canopy, and conversely the canopy can be jettisoned without arming the seats.

Safety features include strong longitudinal beams along the underside of the fuselage; the cockpit area is designed to withstand a local download ultimate load factor of 8*g* and the seats



are designed for 32*g* forward deceleration. Structure around the single crash-resistant fuel cell is stressed for 24*g* on the pressure bulkhead and 20*g* on the wing spar bulkhead; engines and other items of equipment behind the cockpit are designed for a 16*g* forward crash load. The airframe is designed for an ultimate manœuvring load factor of 11.

CANADAIR CL-41 ESTIMATED DATA

Powerplant: One Fairchild J83-R-1 turbojet. Take-off power (I.S.A., s.l.): approx. 2,000 lb.s.t. Alternative installations: General Electric J85, Pratt & Whitney JT-12 or Armstrong Siddeley Viper ASV-8 of similar power.

Dimensions: Span: 36 ft. 4 in. Overall length: 32 ft. 0 in. Overall height: 9 ft. 4½ in. Gross wing area: 220 sq. ft. Sweepback: Nil. Aspect ratio: 6.0 : 1. Undercarriage track: 13 ft. 2.74 in. Wheelbase: 11 ft. 1.25 in.

Weights and Loadings: Wing group: 893.6 lb. Tail group: 200 lb. Body group: 957.8 lb. Landing gear group: 317.7 lb. Control system group: 172.9 lb Nacelle group: 40 lb. Propulsion group: 625 lb. Fixed equipment group: 893 lb. Total weight, empty: 4,100 lb. Crew: 400 lb. Unusable fuel: 39 lb. Engine oil: 6 lb. Miscellaneous equipment: 5 lb. Max. zero fuel weight: 4,550 lb. Usable fuel: 1,950 lb. Max. gross weight: 6,500 lb. Wing loading (max. t-o wt.): 25.5 lb./sq. ft. Power loading (max. t-o wt.): 3.25 lb./lb.s.t.

Performance: Take-off distance to 50 ft., I.S.A. at s.l. at max. gross weight, 1,790 ft. Take-off distance to 50 ft. s.l. at 100° F., at max. gross weight, 2,340 ft. Rate of climb: 4,420 ft./min. at sea level and 1,200 ft./min. at 30,000 ft. Time to 30,000 ft.: 11.7 min. Service ceiling: 45,000 ft. Max. level speeds. at half-fuel weight: 386 knots T.A.S. at sea level and 402 knots T.A.S. at 30,000 ft. Maximum cruising speeds, at half-fuel weight: 343 knots T.A.S. at sea level and 386 knots T.A.S. at 30,000 ft. Stalling speed in landing configuration: 64 knots E.A.S. Landing distance from 50 ft. at s.l. at half-fuel weight: 1,840 ft.

The Canadair CL-44

ALTHOUGH regarded by Canadair as a development and variant of the CL-28 Argus, the CL-44 is very largely a new aeroplane. Both types, however, find a common parentage in the Bristol Britannia and spring from the agreement which Canadair made with Bristol in 1954. Of the two types, the Argus (some new pictures appear on page 268) in fact represents the bigger modification, with its Wright Turbo-Compound piston engines and its almost completely new fuselage with radomes, bomb bays and military interior.

The CL-44, on which the company started investigations in 1956 or earlier, is a close relative of some of the Britannia developments which Bristol themselves projected about the same time, although it is now the only one of these projects which seems likely to be built. From the outset, the proposal was based upon R.C.A.F. requirements for a long-range transport to replace or supplement the Canadair North Stars. Several powerplant installations were studied, including the Wright Turbo-Compounds of the Argus, the Proteus, the Tyne Stage I and the Pratt & Whitney T34, but the choice eventually fell upon the Orion supercharged turboprop.

An order for eight CL-44C transports powered by four Orions each was placed by the R.C.A.F. at the beginning of 1957 and the company got down to detail design. Compared with the Britannia 310, the new aircraft was to have a fuselage lengthened by 12 ft. 4 in., general strengthening of the structure for weights above 200,000 lb., a freight-carrying floor for 300 lb./sq. ft. loadings and two large freight loading doors, in addition to the new powerplant.

The CL-44 project suffered a set-back early this year when the M.o.S. withdrew support for the Orion and Bristol decided they could not continue development of this promising engine at their own expense. Canadair chose, in lieu of the Orion, the Rolls-Royce Tyne R.Ty.12 and by exerting considerable engineering effort they have now re-designed the powerplant installation without affecting the scheduled first flight toward the end of 1959.

With Tynes the aircraft is known as the CL-44D, and is available in three basic forms—a pure freighter, military or civil; a passenger-carrier seating up to 171 (at thrift-class standard) or a combination passenger/freighter. These are known respectively as the Canadair Freighter, Canadair Liner and Canadair Freightliner. The R.C.A.F. specification calls for the CL-44D to be certifiable to CAR 4b requirements.

Structurally, the CL-44D is similar to the Britannia, apart from local strengthening, as already noted, for the higher weight. A feature not found on the Britannia is the gas-turbine A.P.U., specified by the R.C.A.F., to provide a source of power for engine starting through low pressure (50-60 p.s.i.) pneumatic starters on each engine, at airfields where air-starting carts are not available. The A.P.U. can also be used to supply warm or cold air to the cabin for ground conditioning.

The air-conditioning system uses two air compressors, one on each inboard engine. All or a portion of the air can be directed through a mechanical refrigeration system as desired. Regulation of temperature of the crew compartment and main cargo or passenger compartment is independent and fully automatic, with a manual back-up.

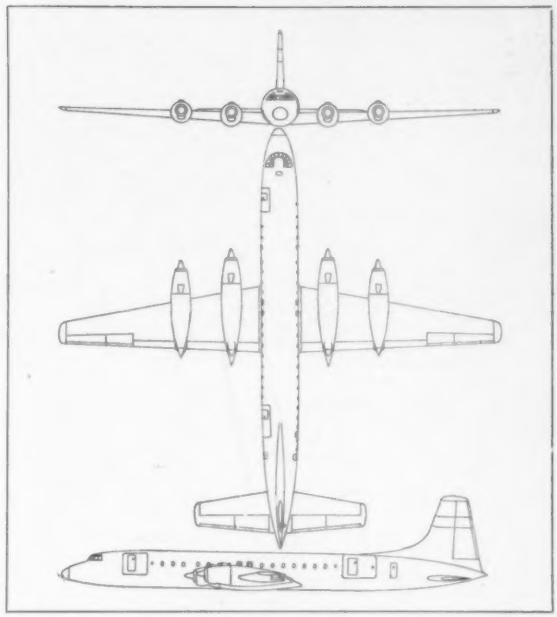
The pressurization system is designed to provide a working differential of 6.55 p.s.i., which corresponds to a cabin altitude of 8,000 ft. at an aircraft altitude of 30,000 ft.

Wing de-icing is provided through ram air which passes over the engine tail-pipes and is ducted into the leading edges. Tail unit de-icing is provided by a dual heater system installed in the rear of the aircraft. Propellers, windscreens, elevator horn balances and auxiliary air intake are de-iced electrically.

The electrical system is a 115-volt, 400-cycle, 3-wire system with the neutral grounded to aircraft structure. The system is powered by three 40-kVA. alternators, driven at 6,000 r.p.m. by constant speed units on engines No. 1, 2 and 4, and designed to operate fully paralleled or independently. In addition, a variable-frequency AC system is to be supplied by three 60-kVA. engine-driven generators. Twenty-eight-volt DC power is provided from transformer-rectifiers powered by the primary AC system.

The fuel system consists of four main tanks and three auxiliaries. The main tanks and outboard auxiliaries are integral type tanks while the centre-section auxiliary is a bag type. All tanks are connected to a manifold and selective single-point underwing refuelling at the rate of 500 Imp. gallons per minute is possible. The total fuel capacity is 10,150 Imp. gallons.

One main hydraulic system is provided. It supplies the main undercarriage retraction, extension and unlatching; undercarriage bogie beam rotation; nose landing gear retraction, extension and unlatching; nose-wheel steering; wheel braking system; control surface ground locks; and cargo door operation. An emergency air system supplies the same services except nose-wheel steering, control locks and freight door operation.



The main hydraulic system is a manual unload 3,000 p.s.i. constant-delivery type, powered by two pumps located on each inboard engine and driven through the constant-speed unit. The emergency system is supplied by stored compressed air.

The flying control system is like that on the Britannia, in which dual controls connected to trailing-edge servo-tabs are provided to actuate the primary control surfaces. The surfaces themselves are not connected to the controls. An artificial feel system, hydraulically operated, senses control displacement and indicated airspeed, and is linked into the input side of the elevator control system. Artificial feel for aileron and rudder is obtained by springs connected to the control circuits.

High-lift double slotted flaps are installed along the wing trailing edge, and are actuated by irreversible screw jacks driven by a common torque shaft through a gearbox. This shaft gearbox is driven by two electric motors actuating a common torque shaft through a differential gearbox. Either motor is capable of operating the flaps.

In the R.C.A.F. version of the CL-44D, to be known as the CC-106, both military and commercial electronic equipment have been selected to ensure that only the latest equipment is used. HF, VHF and UHF communication facilities are provided.

A transistorized intercommunication system is to be installed and a P.A. system with controls at the cockpit and cabin attendants' stations will be provided. On the navigational side, radio compass, radar altimeter, radio range and marker receivers, ILS/VOR equipment, Loran, Doppler and navigational-weather radar equipment are to be provided. A Bendix PB-20H autopilot with ability to be coupled on to ILS will be installed.

CL-44D ESTIMATED DATA

Powerplants: Four Rolls-Royce Tyne R.Ty.12. Take-off power each (I.S.A., s.l.): 5,500 e.h.p. at 15,250 r.p.m. De Havilland four-blade reversing propellers, 16 ft. diameter.

Dimensions: Span: 142 ft. 4 in. Overall length: 136 ft. 9 in. Overall height: 38 ft. 11 in. Gross wing area: 2,075 sq. ft. Sweepback: 7° at 25% M.A.C. Internal cabin dimensions: Length (ex. flight deck): 98 ft. 7 in.; max. width: 138 in.; max. height: 80 in.; max. usable floor area (ex. flight deck): 1,080 sq. ft.; max. usable volume (ex. flight deck): 6,400 cu. ft.

Weights and Loadings: Basic operational: 98,373 lb. Total fuel: 81,200 lb. Mfrs. max. payload: 37,400 lb. Max. take-off: 205,000 lb. Max. landing: 160,000 lb. Max. zero fuel: 155,000 lb. Wing loading (max. t-o. wt.): 99.0 lb./sq. ft. Wing loading (max. landing wt.): 77.2 lb./sq. ft. Power loading (max. t-o. wt.): 9.33 lb./e.h.p.

Performance: Recommended cont. cruising speed (I.S.A.): 325 knots (at 20,000 ft. and 170,000 lb.); consumption: 700 Imp gal./hr.; power (per engine): 3,475 e.h.p. Approach speed (at max. landing wt.): 122 knots. Balanced field lengths: at 205,000 lb., I.S.A. at sea level, 7,250 ft.; at 197,000 lb., I.S.A.+15° C. at sea level, 8,150 ft.; at 197,000 lb., I.S.A. at 5,000 ft., 9,000 ft. Landing distance from 50 ft. (unfactored, max. landing wt.) 3,300 ft. Range (take-off to landing), still air, no reserves, I.S.A., max. fuel (10,150 Imp. gal.): 5,475 naut. mi. with 25,427 lb. payload at 320 knots (mean) at 30,000 ft. (mean). Range (take-off to landing) still air, no reserves, I.S.A., with max. payload, 4,750 naut. mi.

Canadian Aviation Today . . . .

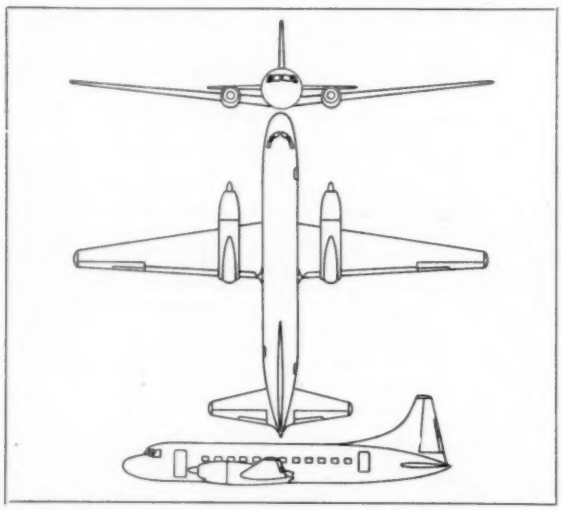
The Canadair 540

IN MAY, 1959, Canadair expect to fly the first of 10 CL-66 transports ordered by the R.C.A.F. Offered for commercial use as the Canadair 540, these aircraft are Convair 440s with Eland engines. The R.C.A.F. contract, concluded earlier this year, set the seal on Canadair's plans, first considered last year, to put this rejuvenated turboprop version of the well-established Convair Metropolitan into production in Canada.

Such a project had previously been studied by Convair, who envisaged the use of Napier Eland engines in a version called the Convair 540, but the demand on floor space at San Diego for production of the 880 led to this idea being abandoned. Both Canadair and Convair are divisions of the U.S. General Dynamics Corporation.

The aircraft as produced in Canada has several designations. Canadair 540 is now the popular name (in place of Cosmopolitan which was favoured at one time). The company designation is CL-66A for the passenger version and CL-66B for the freighter, while the R.C.A.F. designation is CC-109. The freighter has a large cargo door and strengthened floor, as developed by Convair for the C-131.

Production of the Canadair 540 will be in the original Convair jigs, which were moved from San Diego to Montreal during the spring of this year, after Convair had concluded production of the Metropolitan. The aircraft is being re-engineered for the Eland powerplant, this work consisting essentially of "productionizing" Napier's conversion drawings.



Complete powerplants will be obtained from Napier, the present intention being to use Eland 504A engines of N.El.6 rating. The 504A is similar to the 504 used in Napier's previous conversions, but has provision for air starting from an external source or from a Blackburn Palouste in the port nacelle.

Canadair will benefit from Napier's certification of the Eland-engined Convair 340 and 440, and should be able to offer fully certified 540s by the end of next year. The engine itself already has a CAA certificate for civil use. The first of the R.C.A.F. aircraft, which will be cleared for operation at 57,000 lb. compared with the commercial figure of 52,500 lb., is due to be rolled out next March and fly in May. While the production line is being laid down, two of Convair's last 440s are being converted at Montreal to Eland power. These will be used to gain experience with the engine installation and will subsequently be useful as demonstrators, or for R.C.A.F. familiarization.

CANADAIR 540 ESTIMATED DATA

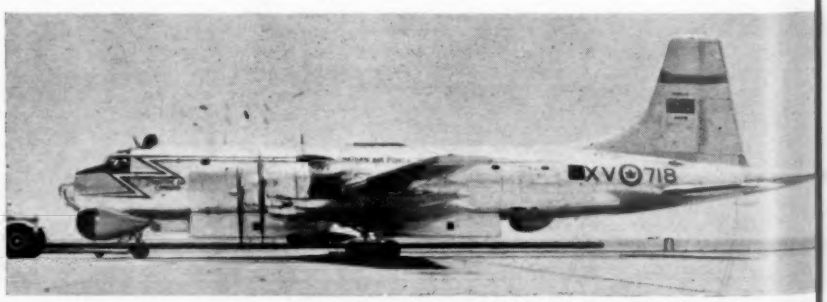
Powerplants: Two Napier Elands 504A (N.El.6). Take-off power each (I.S.A., s.l.): 3,500 e.h.p. at 12,500 r.p.m. De Havilland four-blade propellers: 13 ft. 6 in. diameter.

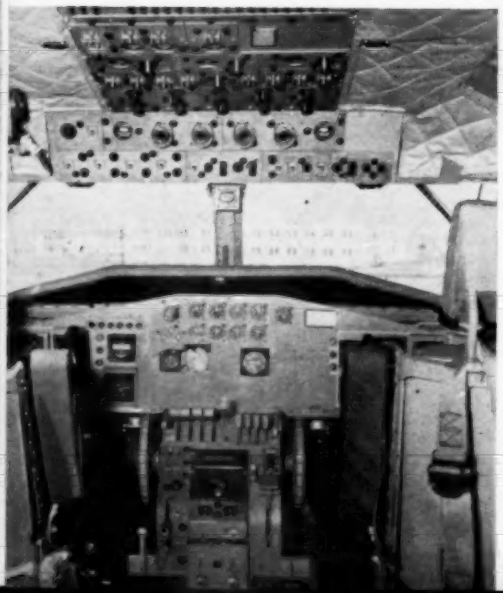
Dimensions: Span: 105 ft. 4 in. Overall length: 81 ft. 6 in. Overall height: 28 ft. 1.6 in. Gross wing area: 920 sq. ft. Sweepback: 4.33° at 25% M.A.C. Internal cabin dimensions: length (ex. flight deck): 54 ft. 10 in.; max. width: 107 in.; max. height: 79 in.; max. usable floor area (ex. flight deck): 396.5 sq. ft.; max. usable volume (ex. flight deck): 2,515.4 cu. ft.

Weights and Loadings: Basic operational: 32,980 lb. Total fuel: 13,668 lb. Mfrs. max. payload: 14,020 lb. Max. take-off: 53,200 lb. Max. landing: 50,670 lb. Max. zero fuel: 47,000 lb. Wing loading (max. t-o. wt.): 57.9 lb./sq. ft. Wing loading (max. landing wt.): 55.1 lb./sq. ft. Power loading (max. t-o. wt.): 7.60 lb./e.h.p.

Performance: Recommended cont. cruising speed (I.S.A.): 284 knots (at 20,000 ft. and 48,000 lb.); consumption 247 Imp. gal./hr.; power (per engine): 3,920 e.h.p. Approach speed (at max. landing wt.): 100 knots. Balanced field lengths (at max. t-o. wt.); at I.S.A. at sea level: 4,650 ft.; at I.S.A.+ 15° C. at sea level: 5,350 ft.; at I.S.A. at 5,000 ft.: 6,100 ft. Landing distance from 50 ft. (unfactored, max. landing wt.): 4,320 ft. Range (take-off to landing), still air, no reserves, I.S.A., max. fuel (1,700 Imp. gal.): 1,860 naut. mi. with 6,552 lb. payload at 275 knots (mean) at 20,000 ft. (mean). Range (take-off to landing) still air, no reserves, I.S.A., with max. payload 820 naut. mi.

The Canadair Argus





The Canadair Argus, derived from the Britannia for use by the R.C.A.F. Maritime Air Command, is now in operational service, equipping No. 405 Squadron. Deliveries of the CP-107 Argus to this unit began at the end of April, just over a year after the aircraft's first flight on March 28, 1957. These photographs show one of the squadron's aircraft, the Argus flight deck, and one of the two bomb bays. Aircraft of the second contract (commencing with Argus number 14) have various modifications, including a smaller front radome. More than 30 are on order.

Howard Levy photographs

Canadian Aviation Today . . . .

The de Havilland Caribou

ON July 30, Canada's newest aircraft, the de Havilland Caribou, made an hour-long first flight from the maker's airfield at Downsview, outside Toronto. The first flight followed a series of hops made the previous day, and was made without fanfare as this first aircraft is not at present fitted with the final leading and trailing edge flaps, design of which will be settled after preliminary flight trials have been completed. No photographs of the completed aircraft are being released at present.

The design of the Caribou is the result of discussions between the Canadian de Havilland company, the U.S. Army and the Canadian Army, which took place in 1956, on the basis of de Havilland design studies for an aeroplane in this category and known provisionally as the Twin Otter. Serious design work began in January, 1957, by which time the DHC-4 was substantially as it is today with the exception of a twin tail unit.

In this form, five Caribous were ordered by the U.S. Army for evaluation as utility cargo and personnel transports, and the Canadian Government signified its support for the project with an order for two, placed by the R.C.A.F. on behalf of the Canadian Army. Construction of this batch of aircraft is now well in hand and D.H. are planning to lay down a further production batch of 10 Caribous. Structural testing of the first partial airframe began in May and a complete programme covering all flight cases is to be covered.

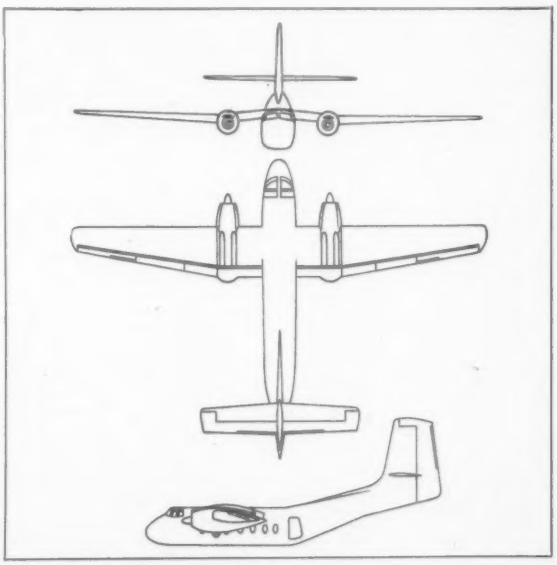
Broadly, the Caribou sets out to provide the capacity of a DC-3, combined with STOL characteristics and direct rear loading into the fuselage. Within a gross weight of 24,000 lb., the Caribou takes a payload of 7,600 lb. over short ranges as a freighter. With conventional coach-class seating in a civil passenger role it will accommodate 27 passengers three abreast; remembering, however, that some DC-3s, with a narrower fuselage than the Caribou, provide four-abreast seating, this, presumably could be increased for certain specific operations. Provision can be made for toilets and/or galley by reducing the seating capacity.

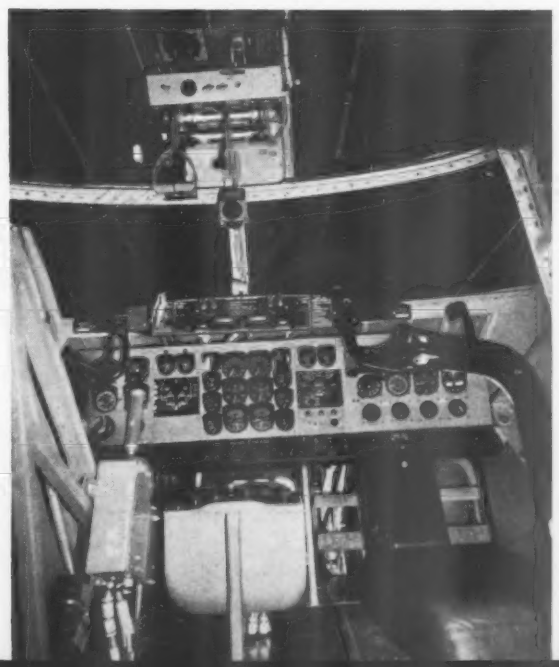
When operating in accordance with the American CAR 4b code (to which standard the Caribou is being built), the take-off distance required is just over 2,000 ft. Using a short-field technique, in zero wind, the actual ground run is 490 ft. and the distance to 50 ft. (both engines operating) is 840 ft. The Caribou is designed to use double-slotted flaps, of the type developed for the Otter, over the whole wing span, with the outer rear portions operating as ailerons; leading-edge flaps are also to be used.

The Caribou structure is simple and orthodox, with a two-spar wing having conventional web spars, ribs, stringers and skin built in three parts—two outer panels attaching to a one-piece centre-section carrying the engine nacelles. Fuel is carried in bag tanks between the spars. The square section fuselage is built up of frames and stringers, the principal materials being 24ST and 75ST alloy.

The Caribou has a 3,000 p.s.i. hydraulic system to power the undercarriage, nose-wheel steering and brakes. Electric system is 28 V DC from two engine-driven generators with 115 V AC available through rectifiers. Wing de-icing is by rubber boots, with fluid de-icing of the propeller blades and an electrically-heated windscreen.

The U.S. Army has already stated an interest in a turboprop version of the Caribou, and this is likely to be developed in due course with unspecified engines. Engines for the initial version of the Caribou are all reconditioned R-2000s, supplied by Canadian Pratt & Whitney.





ESTIMATED DATA

Powerplants: Two Pratt & Whitney R-2000-7M2. Take-off power each (I.S.A., s.l.): 1,450 h.p. at 2,700 r.p.m. Hamilton Standard c.s., f.f. 3-blade propeller, 13 ft. 1 in. diameter.

Dimensions: Span: 96 ft. 0 in. Overall length: 68 ft. 10 in. Overall height: 31 ft. 9 in. Gross wing area: 912 sq. ft. Sweepback: Nil. Internal cabin dimensions: length (ex flight deck): 25 ft. 0 in.; max. width: 87 in.; max. height: 75 in.; max. usable floor area (ex. flight deck): 152 sq. ft.; max. usable volume (ex. flight deck): 1,000 cu. ft.

Weights and Loadings: Basic operational: 16,355 lb. Total fuel: 5,040 lb. Mfrs. max. payload: 6,800 lb. Max. take-off: 24,000 lb. Max. landing: 24,000 lb. Max. zero fuel: 24,000 lb. Wing loading (max. t-o. wt.): 26.3 lb./sq. ft. Power loading (max. t-o wt.): 8.3 lb.

Performance: Recommended cont. cruising speed (I.S.A.): 154 knots (at 7,500 ft. and 24,000 lb.); consumption: 48.7 Imp. gal./hr.; power (per engine): 725 b.h.p. Approach speed (at max. landing wt.): 67 knots. Balanced field length (at max. t-o wt.): at I.S.A. at sea level: 2,070 ft. Landing distance from 50 ft. (unfactored, max. landing wt.): 1,000 ft. Range (take-off to landing), still air, no reserves, I.S.A., max. fuel (700 Imp. gal.): 900 naut. mi. with 2,645 lb. payload at 130 knots (mean) at 7,500 ft. (mean). Range (take-off to landing) still air, no reserves, I.S.A., with max. payload: 870 naut. mi.

Canadian Aviation Today . . . .

The Ancillary Industry

Supporting the aircraft and engine manufacturers in Canada are many hundreds of suppliers of materials, accessories and equipment. This brief directory includes the most important companies in this category.

Abercorn Aero, Ltd., 7435 Chester Avenue, N.D.G., Montreal 29, Quebec
Manufacturers and suppliers of air/sea rescue and electronic equipment, seats, etc.

Adalia, Ltd., 810 Castle Building, 1410 Stanley Street, Montreal, Quebec.
Consultants, telecommunications, navigation, data processing, electronic computation, prototype development.

Aeroquip (Canada), Ltd., Toronto 19, Ontario.
Manufacturers of hose assemblies, fittings, self-sealing couplings, clamps, joints and tie-down equipment.

Air-Ex Inc., Montreal Airport, Dorval, Quebec.
Aircraft repair, overhaul and salvage.

Aircraft Appliances and Equipment, Ltd., 585 Dixon Side Road, Box 177, Toronto 15, Ontario.
Manufacture, distribution and repair of electrical and electronic equipment, including Jack and Heintz products.

Aircraft Industries of Canada, Ltd., P.O. Box 100, St. Johns, Quebec.
Overhaul, repair, conversion of military and commercial aircraft, including R.C.A.F. Dakotas and Harvards.

Aircraft Overhaul and Repairs, Ltd., P.O. Box 429, Grand'mere, Quebec.
Aircraft and engine repairs and overhauls.

Aluminium Co. of Canada, Ltd., 1155 Metcalfe Street, Montreal, Quebec.
A primary source of aluminium alloys, bars, cables, carlings, circles, extrusions, foil, forgings, ingots, plate, rivets, rod, sheet, strip, tube and wire.

Aro Equipment of Canada, Ltd., P.O. Box 515, Toronto 15, Ontario.
Design, development, manufacture and overhaul of oxygen systems and components.

Aviation Electric, Ltd., 200 Laurentien Boulevard, Montreal 9, Quebec.
Sales and service, manufacture and overhaul of aircraft, marine and industrial products. Canadian affiliate of Bendix Aviation Corpn. and distributor in Canada of the aviation products of Hymatic Engineering, Lodge Plugs, Teddington Controls and others.

Aviation Electric Pacific, Ltd., Vancouver Airport, Vancouver, British Columbia.
Sales, service, engineering and overhaul of aircraft instruments and accessories.

Avro Aircraft, Ltd., Box 4004, Terminal A, Toronto, Ontario.
Designers and manufacturers of aircraft (see pp. 261-264).

Bancroft Industries, Ltd., P.O. Box 68, Place d'Armes, Montreal, Quebec.
Distribution of aircraft hardware, accessories and equipment, overhaul of aircraft instruments.

Berry Brothers, Inc., 1106, Walker Road, Walkerville, Ontario.
Aircraft finishes.

Bristol Aero-Engines, Ltd., 10210 Pie IX Boulevard, Montreal North 12, Quebec.
Overhaul, repair and sales of aero-engines and parts (see pp. 261-264).

Bristol Aero-Engines (Western), Ltd., Vancouver Airport, Vancouver, British Columbia.
Repair and overhaul of aero-engines, propellers and carburetters (see pp. 261-264).

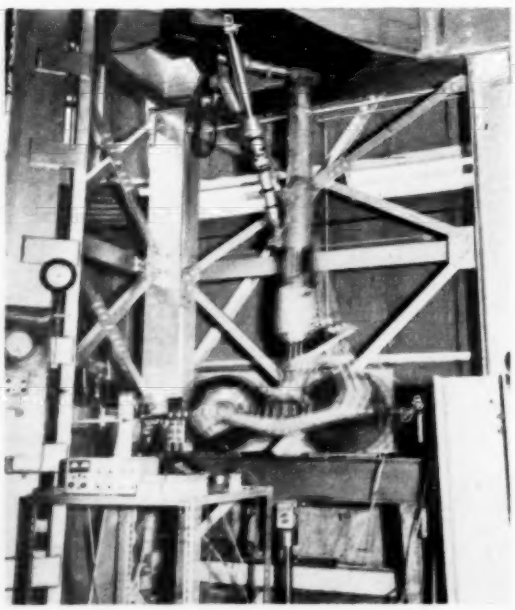
Bristol Aeroplane Co. of Canada (1956), Ltd., International Aviation Building, Dorchester Street West, Montreal, 3, Quebec.
Holding company for aircraft and aero-engine repair subsidiaries (see pp. 261-264).

Bristol Aircraft (Western), Ltd., Stevenson Field, Winnipeg, Manitoba.
Sales and overhaul, manufacture of components for aircraft and aero-engines (see pp. 261-264).

Brunswick-Balke-Collender Co. of Canada, Ltd., 38 Hanna Avenue, Toronto, Ontario.
Fabrication of reinforced plastics for aircraft.

Canadair, Ltd., P.O. Box 6087, Montreal, Quebec.
Aircraft design and manufacturing; research and development of guided missiles and nuclear reactors (see pp. 261-264).

Canadian Applied Research, Ltd., 1500 O'Connor Drive, Toronto 16, Ontario.
Design, engineering and production of instrumentation equipment for application in the fields of aviation, photography, photogrammetry and aerial survey.



Dowty designed and constructed this test rig specially for retraction, fatigue and shock absorber closure tests on the notable Arrow main landing gear. In this test, a leg with dummy wheels is being deflected through about four inches by cyclic loadings of 15,000 lb. forwards and 9,000 lb. aft, while constant vertical load is applied.

Canadian Aviation Electronics, Ltd., Head Office, Eastern Division, P.O. Box 915, Station O, Montreal 9, Quebec.
Development, manufacture, installation, repair and overhaul, consultants, radio, radar simulators, industrial electronics. This company is a pioneer of the aviation electronic industry in Canada, of more than 10 years' standing. Its products include CF-100 flight simulators and a DC-6B simulator for C.P.A.L.

Canadian Car Co., Ltd., 621 Craig Street West, Montreal 3, Quebec.
Manufacturing, repair and overhaul; tooling design and manufacture (see pp. 261-264).

Canadian Flight Equipment Cobourg, Ltd., 67 Yonge Street, Toronto, Ontario.
Cartridge-actuated devices.

Canadian Marconi Co., Aviation Department, Commercial Products Division, 970 McEachran Avenue, Montreal 8, Quebec.
Design, manufacture, sales and service of aviation radio equipment. The aviation department specializes in meeting aircraft radio requirements in Canada and the U.S., and has produced an ADF and an HF transmitter/receiver among other items.

Canadian Pratt & Whitney Aircraft Co., Ltd., Longueuil, Montreal 23, Quebec.
Manufacture of aero-engines and spare parts and supply, and service of engines, propellers, accessories and helicopters (see pp. 261-264).

Canadian SKF Co., Ltd., 2201 Eglinton Avenue East, Scarboro, Ontario.
Manufacture of ball and roller bearings.

Canadian Steel Improvement, Ltd., 289 Horner Avenue, Toronto 14, Ontario.
Forging in high-temperature alloys, aluminium and titanium. All types of castings in aluminium and magnesium. Recognized as a specialist in precision titanium forging, and at work on a number of orders from U.S. companies in addition to components for the Arrow, Iroquois and other Canadian aircraft.

Cannon Electric Canada, Ltd., 160 Bartley Drive, Toronto 16, Ontario.
Manufacturers of electrical connectors for aircraft and electronic applications.

Carriere and McFeeters, Ltd., P.O. Box 220, O'Connor Drive Postal Station, Toronto 16, Ontario.
Aircraft accessories and instruments—sales and service. Manufacture of relays.

Collins Radio Co. of Canada, Ltd., 11 Bermondsey Road, Toronto 16, Ontario.
Manufacturers of airborne communications and navigation equipment, and point-to-point communications.

Computing Devices of Canada, Ltd., Bells Corner, P.O. Box 508, Ottawa 4, Ontario.
Electronic and electro-mechanical development and manufacture and data-processing services. Products include the Position and Homing Indicator Mk. 3 dead-reckoning automatic navigator and the ANTAC long-range navigation system for the Argus.

Cossor (Canada), Ltd., 301-303 Windsor Street, Halifax, Nova Scotia.
Production of VHF ground transmitters; servicing and installation of electronic equipment in the Argus, Tracker and Banshee; electronic research and development.

Crystal Glass and Plastics, Ltd., 130 Queen's Quay East, Toronto 2, Ontario.
Suppliers of plastic materials; fabrication of plastics components.

Decca Radar (Canada), Ltd., 23 Six Points Road, Toronto 18.
Canadian representative of the parent Decca company for the installation and development of ground radar equipment at airports and elsewhere.

(*Continued on page* 271)

Canadian Aviation Today . . . .

(*Continued from page* 270)

The de Havilland Aircraft of Canada, Ltd., Downsview, Ontario.

Manufacture of utility transport aircraft, skis, amphibious floats. Overhaul of engines, airframes (see pp. 261-264).

Dominion Rubber Co., Ltd., Mechanical Goods Division, 550 Papineau Avenue, Montreal, Quebec.

Manufacture of all types of industrial rubber products, tyres, fuel cells.

Dowty Equipment of Canada, Ltd., Ajax, Ontario.

This company has made great progress since its formation in Canada 12 years ago. The biggest production job to date has been the production of CF-100 undercarriages, but the most significant design achievement has, without doubt, been the development of the main undercarriage for the CF-105. The design of the Arrow imposed particularly stringent requirements on the undercarriage designer, which could be met only by using structural components in steel having a tensile strength of 280,000 lb./sq. in., of a kind not before used in Canada. The Arrow leg incorporates a Dowty Liquid Spring shock-absorber and tandem wheel pairs.

Other production work is concerned with landing gear and hydraulic system components for the CS2F-1 Tracker, Beaver, Caribou and CL-28. Through its manufacturing and sales agreement with the aviation division of the Dunlop Rubber Co., Dowty manufactures, sells and services wheels, brakes, valves and Maxeret units for Canadian-built and -operated aircraft.

Dunlop Canada, Ltd., 870 Queen Street East, Toronto 8, Ontario.

Representative in Canada of the Dunlop group of companies.

Edo (Canada), Ltd., P.O. Box 97, Cornwall, Ontario.

Manufacturer of seaplane floats, underwater acoustic equipment, hydrodynamic research equipment.

Enamel and Heating Products, Ltd. (Aircraft Division), P.O. Box 9, Amherst, N.S.

Manufacture and repair and overhaul of all types of aircraft components. Subcontract work includes tail units and rear fuselages of the CS2F-1. Company also holds repair and overhaul contracts for R.C.A.F. and R.C.N. aircraft.

Fairey Aviation Co. of Canada, Ltd., Eastern Passage, Nova Scotia. Head office, P.O. Box 69, Dartmouth, N.S.

Repair, overhaul modification, conversion of aircraft. Manufacturer of hydraulic systems and aircraft parts (see pp. 261-264).

Field Aviation Co., Ltd., P.O. Box 366, Municipal Airport, Oshawa, Ontario.

Aircraft overhaul, light manufacturing, sales of aircraft and aircraft supplies.

Fleet Manufacturing, Ltd., P.O. Box 300, Fort Erie, Ontario.

This company holds Canadian manufacturing rights for the Helio Courier and has built a few examples, but the principal activity is now concerned with sub-contract work on the CF-100, CF-105, CS2F-1, Beaver and Otter.

The Garrett Manufacturing Corpn. of Canada, Ltd., 4 Racine Road, Rexdale, Ontario.

Sales, service, repair and overhaul, and manufacture of aircraft components. Subsidiary of the Garrett Corpn. of Los Angeles.

Godfrey Engineering Co., Ltd., 480 Metropolitan Boulevard, Lachine, Montreal 32, Quebec.

Manufacturers of aircraft pressurization systems and ground servicing equipment. An affiliate of Sir George Godfrey and Partners.

B. F. Goodrich Canada, Ltd., Dunber Building, Kitchener, Ontario.

Rubber manufacture.

Goodyear Tire and Rubber Co. of Canada, Ltd., New Toronto, Ontario.

Manufacturers of tyres, tubes, wheels, brakes, hose, airfoam and moulded rubber parts.

Honeywell Controls, Ltd., Vanderhoof Avenue, Leaside, Toronto 17, Ontario.

Development, design, manufacture, distribution, repair and overhaul of automatic controls and instruments.

Jarry Hydraulics, 4384 St. Denis Street, Montreal 18, Quebec.

Design and manufacture of aircraft hydraulics and landing gear. Since 1950 this company has built a sound reputation for their products, which are now used in virtually every type of Canadian-built aircraft.

Walter Kidde and Co. of Canada, Ltd., 550 Royalmount Avenue, Montreal 9, Quebec.

Manufacture and repair of fire protection, pneumatic apparatus and inflation equipment.

Lucas-Rotax, Ltd., Box 115, Station H, Toronto 13.

Like its British parent, the Canadian Lucas-Rotax company offers an integrated service from design to quantity production of fuel-control systems, aircraft electrics, hydraulic and combustion equipment. The main production plant at Scarborough, in Toronto, now comprises nearly 150,000 sq. ft., including the engineering development building which came into use early in 1957.

To match the performance of Canada's most advanced aircraft and aero-engine—the Arrow and the Iroquois—Lucas-Rotax have had to solve some tough problems. Products for these two applications include the complete Iroquois fuel system with a high-capacity reheat fuel pump, and the whole generating system for the Arrow.

Overhaul and repair operations are undertaken on the Orenda, Nene, J34 and Dart fuel systems and the Britannia 314 electrics and fuel systems at Montreal and at a newer establishment at Vancouver Airport.

Martin-Baker Aircraft Co., Ltd., Collingwood, Ontario.

Production of ejector seats; repair and modification work.

Noorduyn Norseman Aircraft, Ltd., P.O. Box 5, Montreal 9, Quebec.

Sales, manufacture, repair and overhaul of aircraft and parts.

Normalair (Canada), Ltd., 1425 The Queensway, Etobicoke, Toronto 14, Ontario.

Manufacturing, sales and service of aircraft pressurization, conditioning and breathing equipment.

Orenda Engines, Ltd., Box 4015, Terminal A, Toronto, Ontario.

Jet-engine design, development, manufacture and service (see pp. 261-264).

Phœnix Engineered Products, Ltd., 750 Lawrence Avenue, Toronto 19.

Manufacture and overhaul of aircraft instruments, telemetering and photogrammetric equipment.

Prenco Progress and Engineering Corpn., Ltd., 72-74 Stafford Street, Toronto, Ontario.

Design and manufacture of aircraft hydraulic components and ground equipment.

Pye Canada, Ltd., 82 Northline Road, Toronto 16.

Representative in Canada of the Pye Group of companies.

RCA Victor Co., Ltd., 1001 Lenoir Street, Montreal, Quebec.

Commercial and defence electronics products and systems engineering.

Renfrew Aircraft and Engineering Co., Ltd., Renfrew, Ontario.

General sub-contractor, major components and ground refuelling equipment.

Rolls-Royce of Canada, Ltd., 6265 Côte de Liesse Road, Montreal, Quebec.

Manufacture, overhaul and repair of aero-engines and parts (see pp. 261-264).

Rousseau Controls, Ltd., 640 de Courcelle Street, Montreal 30, Quebec.

Hydraulic, pneumatic, pressure and temperature controls.

Servomechanisms (Canada), Ltd., Rendale Boulevard and Kipling Avenue, Toronto 15.

This company represents the U.S. concern of the same name and manufactures the complete Servomechanism range of computers and other equipment.

Simmonds Aerocessories of Canada, Ltd., 5800 Monkland Avenue, Montreal 28.

Manufacture of aircraft accessory equipment and representative of Hi-Shear, King Aircraft Corpn. and Saunders Valve.

S. Smith and Sons (Canada), Ltd., 105 Scarsdale Road, Don Mills, Ontario.

Supply, overhaul and repair of all equipment manufactured by the Smiths group of companies.

Sperry Gyroscope Co. of Canada, Ltd., 6011 Côte de Liesse Road, Montreal, Quebec.

Development, manufacture and overhaul of aircraft, navigational, flight and fire-control equipment. The company manufactures instruments to the design of the parent company and also provides service for other Sperry products.

Standard Aero Engine, Ltd., P.O. Box 764, Winnipeg.

Overhaul and repair of aero-engines.

Technical Enterprises, Ltd., Malton Airport, Toronto, Ontario.

Sales, service, engineering and installation of airborne electronic equipment.

Vertol Aircraft Co. (Canada), Ltd., Arnprior Airport, Arnprior, Ontario.

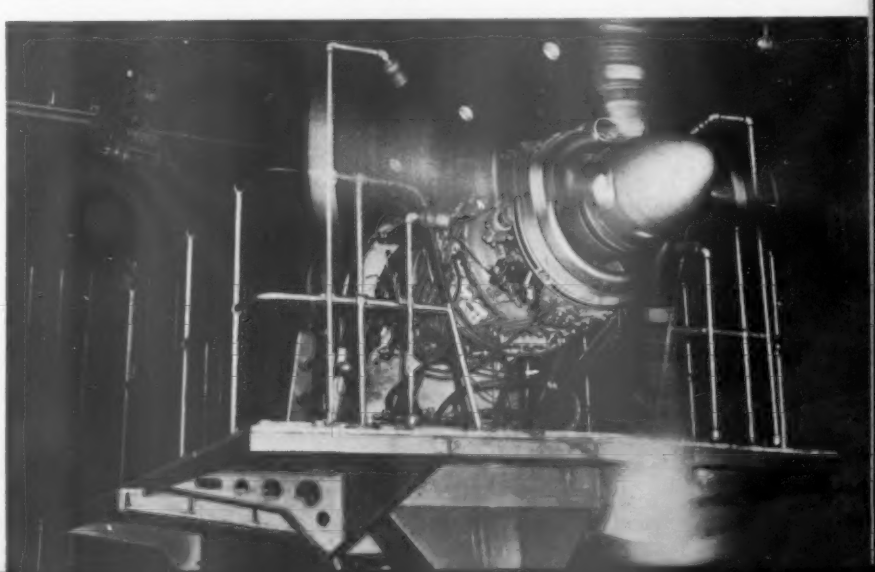
Manufacture, overhaul, repair and maintenance of aircraft and aircraft parts.

The Weatherhead Co. of Canada, Ltd., 109 Inkerman Street, St. Thomas, Ontario.

Manufacture and distribution of aircraft and tube fittings and flexible hose assemblies.

X-Ray and Radium Industries, Ltd., 261 Davenport Road, Toronto, Ontario.

Manufacturers of luminous paint; sales and service of flow-meters, X-ray, Gamma cameras, nuclear instruments, edge lighted panels.



Facilities for the overhaul of the Dart engine were established at Rolls-Royce of Canada Limited at Montreal in March this year. First engines to be received were from Cubana, the Cuban Viscount operator. A Dart is seen on test at the new facility in this picture.

Impressions of the Structural Design of American Civil Aircraft—2

by A. F. Newell, M.I.Mech.E., A.F.R.Ae.S.

FOLLOWING on from Part I of this series (THE AEROPLANE, August 15) it is proposed to devote this section to the review of the structural concepts and details of the Boeing 707, Douglas DC-8 and Lockheed Electra fuselages.

The purely structural effort required to design a large, highly pressurized fuselage with numerous cut-outs for windows and door is a formidable one. To make adequate provision against catastrophic failure from fatigue and corrosion on the one hand and from external damage caused by "foreign" objects such as propeller or turbine blades on the other hand, further complicates the task.

The trend today is to make a fuselage of fail-safe design, wherein structural safety is provided by the multi-load path concept, and to achieve this safety for as low a weight penalty as possible.

The fuselages under review are claimed to achieve exactly this point, but the detail design is vastly different and, as detailed weight breakdowns are not available, it is not possible at this stage to see if the claims are justified.

However, the principles in common in American fuselage design can be stated as follows:—

I. Uniformity of low stress levels due to the hoop tension in the fuselage skins;

II. Cut-outs, such as doors and windows, are reinforced so that the fatigue life is at least equal to that of the basic uncut shell;

III. The pressure shells are constructed of materials having good fatigue and tear resistant properties *or* they are provided with crack-stopping circumferential rings.

Before passing on to details it must be emphasized that the experience gained from the British D.H. Comet has been of great benefit to the Americans, and in presenting some of their design practice we in turn may learn from them.

Boeing 707 Fuselage

If reference is made to the side elevation of the 707 fuselage in Fig. 6, it will be noted that straps are indicated over the top portion of the fuselage. For clarity, no frames are shown. The straps are crack stoppers and are spot-welded inside the fuselage skins. Details of these straps are given in Fig. 7 and the important thing to note is that these reinforcing straps occur only at the top of the fuselage.

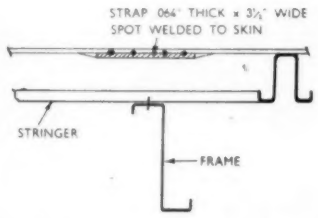
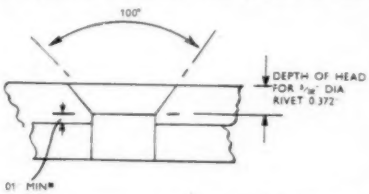


Fig. 7. Strap and frame design. Reinforcing straps (crack stoppers) on top of fuselage only. Thick straps necessitate stringers to be joggled over strap.

This indicates a policy which is peculiar to Boeing, namely that the top of the fuselage is the main worry from a fatigue viewpoint. In normal loading the top of the fuselage is in tension due to down loads on the tail and to inertia loads. These loads are in action whilst the cabin is pressurized. It should also be noted that the skin over the top of the rear fuselage is thicker than the bottom.

Some effort has been made to be as accurate as possible with regard to skin thicknesses in Fig. 6. The skins operate at a nominal hoop tension stress of 13,000 p.s.i. However, in designing the fuselage, the pressure loads are multiplied by a factor of three on the tension or upper skins and by a factor of two on the compression or lower structure. The skins are made of 24 ST where pressure stresses predominate; the stringers and frames are of 75 ST.

The fuselage pressure differential is 8.6 p.s.i. The windows are small (12½ in. by 9 in.) and occur between frames; this gives two windows per seat-spacing in most seating configurations. This form of window layout is very pleasing from inside the cabin, because it is possible to see through a window if sitting on the seats nearest the gangway. The frames are 20-in. pitch.



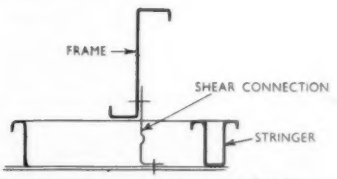
Reduced countersunk head rivet. Typical riveting in thin skins.

Fig. 8. Rivet details.

At first glance there appears to be nothing out of the ordinary in the type of skin joints used on the fuselage. All the longitudinal joints in the skins are simple lap joints fastened by three rows of rivets. However, Boeings have committed themselves to a new type 100° head rivet for use in countersunk holes in thin aluminium-alloy sheet when high fatigue resistance is required.

These rivets are similar to AN-426 rivets, but have a reduced height head similar to the head of Hi-Shear rivets. The object of the reduced head is to eliminate the knife edge; Fig. 8 shows this and the minimum depth of skin specified on thin sheets when using these rivets. When used in thin sheet, these rivets have a higher fatigue and static strength in shear than AN-426 rivets, but lower strength in tension.

Table I gives a comparison of the tensile strength of thin sheet joints fabricated with AN-426 rivets and with the reduced head rivets. Fatigue curves for the two types of rivets loaded in tension are shown in Fig. 9. It is of interest to note that Boeing's tests show that reduced head rivets in countersunk holes have a higher fatigue strength than standard



Shear connection at bottom of fuselage (no straps).

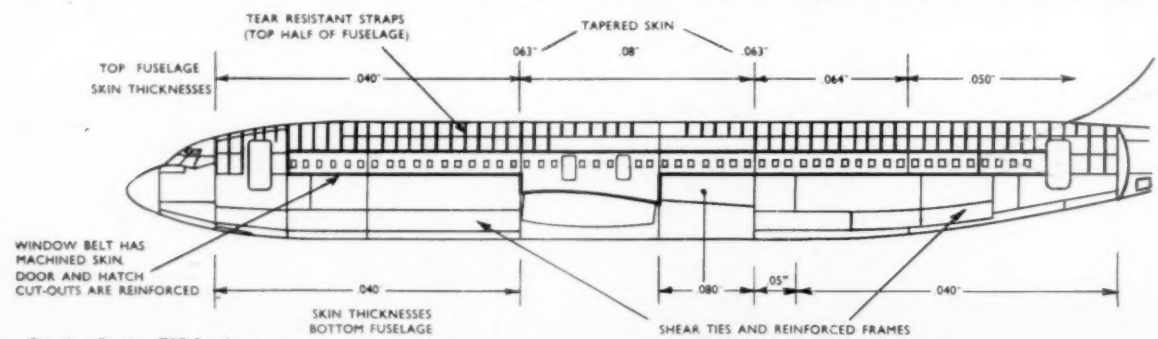


Fig. 6. Boeing 707 fuselage.

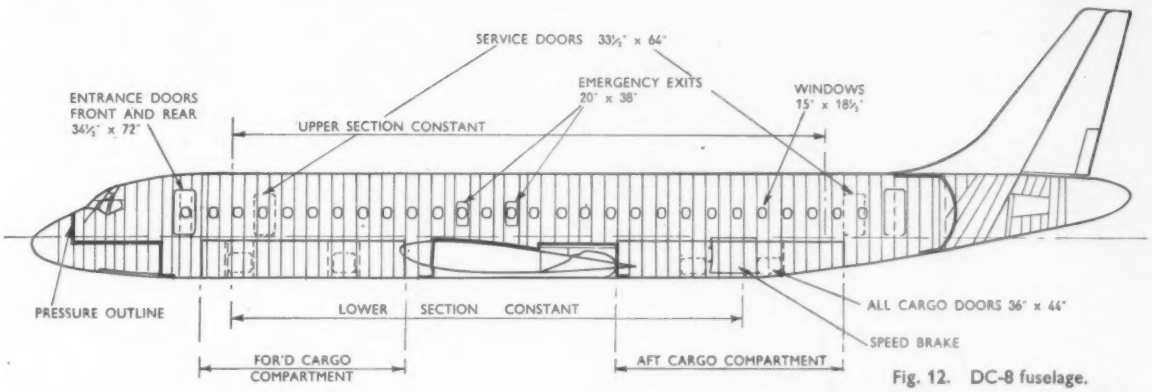

SERVICE DOORS 33½" x 64"
EMERGENCY EXITS 20" x 38"
WINDOWS 15" x 18½"
ENTRANCE DOORS FRONT AND REAR 34½" x 72"
UPPER SECTION CONSTANT
PRESSURE OUTLINE
LOWER SECTION CONSTANT
ALL CARGO DOORS 36" x 44"
SPEED BRAKE
FOR'D CARGO COMPARTMENT
AFT CARGO COMPARTMENT

Fig. 12. DC-8 fuselage.

AN-426 rivets in dimpled holes. However, the static strength of the joints employing the standard AN-426 rivets in dimpled holes is greater.

The window belt region of the fuselage has some interesting features. First, in the region of the windows the heavy skins are machine-sculptored and the window frames are forgings. Three thicknesses of window-frame forgings are used throughout the fuselage in an effort to grade the stress levels in the forgings and at the same time compromise on manufacturing costs. The reason for using forgings is to eliminate stress raisers due to rivets at the window cut-outs.

TABLE 1.
COMPARISON OF TENSILE ALLOWABLES FOR AN-426 AND REDUCED-HEAD RIVETS
(Expressed in pounds per rivet)

Material thickness in inches *	An-426 rivets			Reduced-head rivets		
	Rivet diameter in inches			Rivet diameter in inches		
	5/32	3/16	1/4	5/32	3/16	1/4
0.040	135			145		
0.045	192			167		
0.050	250	265		189	241	
0.056	292	330		213	267	
0.063		395			295	
0.071		487			329	500
0.080						537
0.090						580
0.100						622

NOTE: * All sheet material was clad 2024-T3 Aluminium Alloy.

Lock bolts are used all round the windows and are spaced approximately 1½ in. from the free edge of the window opening. Fig. 10 shows a sketch of how the window forgings are joined together to form a continuous framework through the window belt.

An example of the multi-load concept of the 707 is the windscreen structure in the pilot's compartment. Dual members are used such that if fatigue damage is induced in one of the members, by the selection of a proper design factor the remaining member has enough residual strength to ensure safety. Fig. 11 shows the principle.

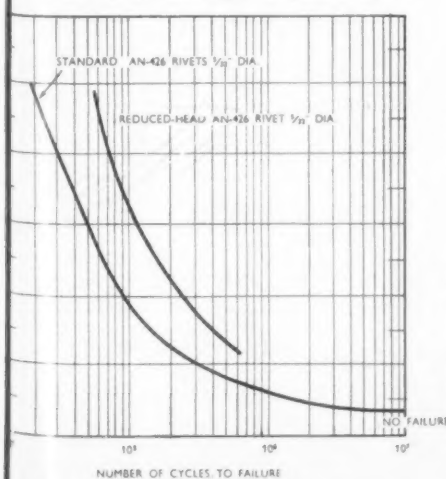


Fig. 9. Fatigue curves for riveted joints in tension.

Fig. 10. Window reinforcing frames.

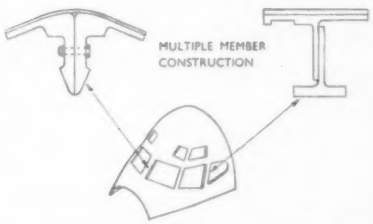


Fig. 11. Windscreen structure.

Douglas DC-8

A side elevation of the DC-8 fuselage is given in Fig. 12. It is not possible to state the skin thicknesses and locations as was done for the 707, but Douglas' policy on skin gauges and materials can be given.

Fuselage skins .071-in. thick and under are made from 14 ST 6 AL: skins thicker than .071 in. are 75 ST 6 AL. Stringers are 75 ST 6 extruded hat sections. Frames are 75 ST 6 extruded Z-sections and are mostly spaced at 20-in. pitch. The fuselage forward section is of conventional type skin-stringer structure. A minimum skin gauge of .050 in. is maintained in the pressure cabin.

Circumferential bands of titanium (A-110 AT) at frames, increase tear resistance where skin is .071 in. or less (see Fig. 13). All frames in the pressurized section are attached to the skin between each stringer. Stresses due to pressure are approximately 12,900 p.s.i. based on the minimum skin gauge.

The detailed approach of Douglas with respect to crack stoppers is totally different from Boeing. The titanium straps are carried all round the fuselage, tension and compression side, and are made thin enough (.025-in. thick) in the hope that the stringers can be pulled down on to the skin to avoid joggling the stringers at every strap. The straps are riveted to the skin as against spot welding with the 707.

Structural integrity, i.e., life before a fatigue crack starts, has been based on work done at the NACA. This has been accepted to be a function of the hoop stress plotted against the ratio of frame area to the area of the associated skin. The pressure differential in the cabin is 8.77 p.s.i.

The longitudinal skin joints are far more elaborate than the 707's. Special care has been taken to keep the stress levels low, grade the skin thicknesses and generally avoid stress concentrations. At a typical joint, a continuous L.A. inner skin, beaded and extending some 5 in. or 6 in. on either side of the joint is riveted inside the outer skin, in addition a special π-section extrusion replaces the normal stringer. In this way the flanges of the extrusion and the inner skin are continuous over the skin joint.

Again the window belt region of the fuselage is totally different from the previous aircraft's. The windows are 15 in. by 18½ in. and are spaced at alternate frames at 40 in. intervals. No forgings are used, but an inner doubler plate with pressed stiffeners acts as a second skin. The addition of the window-frame pressing riveted to the two skins ensures a low stress level and aims at good fatigue life.

Between the wing trailing edge and the aft pressure dome, acoustical requirements dictated mass in addition to the required fuselage shell structure. Rather than add lead soundproofing blankets the structure was made arbitrarily heavy by increasing the skin gauge and using low-crowned hat sections fastened brim to skin and pitched close enough nearly to touch.

As to the interpretation of fail safe, single failures are various combinations of skin cracks with failure of a stringer, or other single element, windshield post, or one element of a door frame.

A great amount of detail testing has

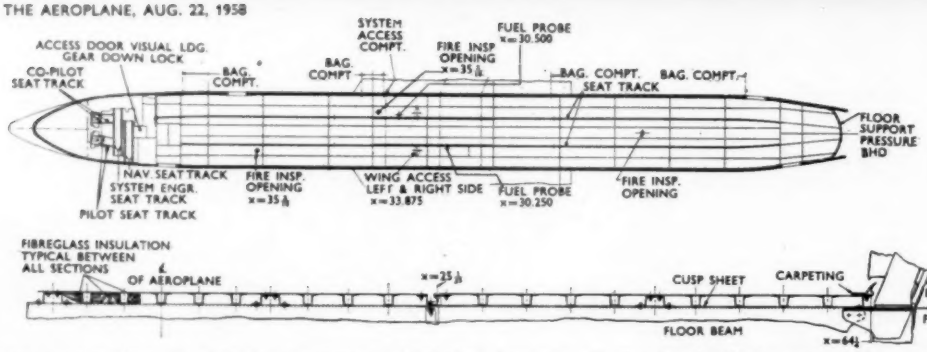


Fig. 14. Douglas DC-8 floor details.

been undertaken by Douglas to prove their structure. A full-scale fuselage from the wing forward has been tested in a water tank. Full pressure loads with allowance for aerodynamic suction and the flight-landing-flight cycle loads are simulated. Up to January of this year something over 50,000 basic cycles have been completed with no significant failures.

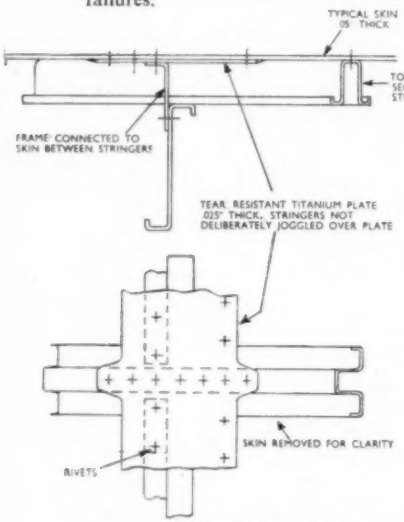

TYPICAL SKIN .05" THICK
TOP HAT SECTION STRINGERS
FRAME CONNECTED TO SKIN BETWEEN STRINGERS
TEAR RESISTANT TITANIUM PLATE .025" THICK, STRINGERS NOT DELIBERATELY JOGGLED OVER PLATE
SKIN REMOVED FOR CLARITY
RIVETS

Fig. 13. Typical frame-strap joint.

A drawing of the floor structure is shown in Fig. 14 and while this is a first-release configuration this is part of the Douglas approach to seat design which has been most thorough. The floor is designed for 9*g* ultimate crash loads. Floor beams approximately 6 in. deep occur at every frame and the top of the floor beam is coincident with the cusp of the double-bubble fuselage. A cusp sheet is attached to the top of the floor beams and together they pick up the pressure loads in tension due to the change of section of the fuselage at this point.

The longitudinal inverted-hat members of the floor are glass-fibre, as also is the insulation between all the longitudinal members.

It should be noted that there are only two seat tracks incorporated in the floor. This means that only the inboard end of the seat is mounted on the floor, the fuselage end of the seats fits into a track attached to the wall of the fuselage.

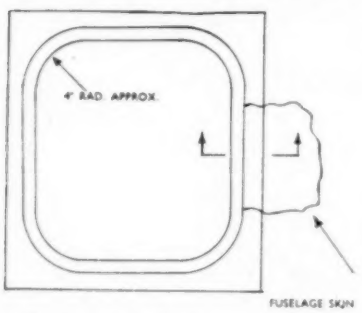


Fig. 15. Forged window frame.

Lockheed Electra

Much has already been said about the fatigue resistant structural approach of Lockheeds. Probably this is because engineers like J. F. McBreaty and E. H. Spalding have given excellent papers on the subject which have deservedly received wide publication.

However, from a brief examination of the Electra fuselage, the overwhelming impression is that the biggest contribution to fail-safe design is the experience gained on the Constellation series. This does not mean that Lockheeds have not benefited from a considerable amount of test work on crack propagation; one is simply saying that the Electra fuselage design is conventional to Lockheed standards, with one or two exceptions.

Aeroplanes like the 707 and DC-8 have pressure differentials of 8.6 and 8.77 p.s.i. respectively, which are much higher than any previous design from these firms. It was the loads arising from these high pressures that caused all the troubles on the Comet and have made all engineers increasingly aware of fatigue, critical crack length and so on.

In the case of Lockheeds, the Super Constellation operates at a differential pressure of 6 p.s.i. and the Electra will operate at 7½ p.s.i. The fuselage is very simple, the cross section is circular over most of its length. The frames are spaced at 19 in. and comprise lipped channels notched to received the rolled-section stringers.

There are no straps added around the frames between the stringers and the skin to form tear-stopping load paths as in the 707 or DC-8, although clips have been added between the stringer and the frames at critical points.

At the maximum diameter the minimum skin gauge is .040 in. thick and reduces to .032 in. at the front fuselage. Stresses due to pressure are 12-14,000 p.s.i. based on minimum gauge. Most of the structure is 7075 aluminium alloy with 2024 aluminium alloy used for the skin panels and bulkhead webs subjected to pressure tension loads.

There is no special feature incorporated in the skin joints. The windows are spaced between alternate frames and measure 16 in. by 18 in. with a 4-in. radius in the corners. Lockheeds, like Boeings, favour forgings for the window-frame design. A single-piece forged 14 ST window frame is shown in Fig. 15, where it will be seen that the fuselage skin is trimmed back 1 in. from the edge of the window opening to remove the skin from the region of highest stress concentration. The relatively heavy forged frame itself reduces the stress level further by virtue of its bulk.

The windshield of commercial transport must protect the flight crew from a 4-lb. bird strike while flying at the design cruising speed, according to the present C.A.A. criteria. Lockheeds have developed their windshield using a special-design bird gun.

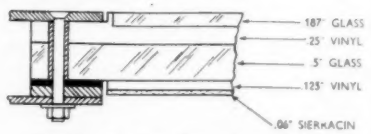


Fig. 16. Section through windshield.

A sketch of the cross-section of the windshield is given in Fig. 16. The feature here is the addition of Sierracin, a hard flat good optical surface which protects the inner thin layer of vinyl. The ¼-in. thick layer of vinyl placed directly behind the main load-carrying glass eliminates the danger from flying glass should the windshield receive a direct hit from a bird.

The Electra fail-safe development programme includes a fuselage fail-safe demonstration. The fuselage will be pressurized to normal operating pressure and loads applied to represent the C.A.A. required flight loading. Thirty-five cuts are to be inflicted as representing damage in the most critical areas of the structure.

It is not proposed to describe this damage, but in general it is being assumed that one stringer and two skin bays, approximately 12 in., are cracked in the transverse direction, several of these cuts will be simulated at once. In the longitudinal direction 12-in. cuts are to be made between frames. Also a frame is to be broken with a crack extending 12 in. long.

A turboprop aircraft like the Electra does not have the same noise problem as the large turbojet aircraft; even so, to reduce noise and fatigue in the plane of the airscrews, the propeller tip clearance to the fuselage is 5 ft.

SUMMARY OF FUSELAGE CONSTRUCTION

	Frames	Skins where pressure stresses predominate	Stringers	Window reinforcement
Boeing 707	20 in. Pitch 75 ST plus partial A1 alloy tear bands	24 ST Stress level 13,000 p.s.i.	75 ST	Forgings 7079.T6
DC-8	20 in. Pitch 75 ST plus complete titanium tear bands	>.071 in. thick 75 ST 6 AL <.071 in. thick 14 ST 6 AL Stress level 12,900 p.s.i.	75 ST6	Plate reinforcement
Electra	19 in. Pitch 75 ST no tear stoppers	24 ST Stress level 12–14,000 p.s.i.	75 ST	Forgings 14 ST

Handley Page Military Transport . . . .

(*Continued from page* 252)

H.P.111 has flaps which are much more effective than those of the Victor. Its inboard flaps are "blown" ones of the Attinello type; they extend across beneath the fuselage. For short landing runs these flaps are lowered 60° and blown, increasing wing lift coefficient by 20%. For take-off they are lowered 15° and not blown. Handley Page studies indicate that blown flaps are most economically supplied with compressed air if it is provided by an auxiliary power unit.

Other features which help the H.P.111 in its short-field or "assault landing," performance are its large, infinitely variable air brakes —of the pattern used on the Victor—for controlling the approach, reverse-thrust from its Rolls-Royce Conways (each gives a braking thrust of 5,000 lb.) and a tail parachute. Wheel braking is assisted by cutting off the compressed-air supply to the blown flaps at touchdown, which immediately reduces lift and increases brake effectiveness.

The main undercarriage has 12-wheeled bogies which permit low tyre pressures for operation from semi-prepared strips. For landing on very soft surfaces a folding skid is attached to the wheels. When the skid is extended the effective tyre pressure can be reduced to about 45 p.s.i.

The forward section of the fuselage has two decks; on the upper one is a passenger cabin and on the lower deck a freight hold. Behind and stretching to the rear door is the main hold, 40 ft. long and 11 ft. 6 in. wide and high. This hold has either a single or double deck depending on loads.

The main hold has a composite floor with upper and lower components. For light freight or personnel a two-deck layout is used, with the upper floor-component forming a separate upper deck at mid-fuselage level. For heavy loads both floors form a single heavy-duty floor at the lower level, giving the aircraft a single deck of increased height. For conversion the upper floor is lifted by freight hoists.

For long-range trooping the H.P.111 carries 202 men in aft-facing 15-g seats pitched 34 in. apart. The aircraft can fly over most Transport Command routes with a full load. A typical load could be 32 soldiers, seven Land-Rovers and trailers or 24 men and a light A.A. gun with its tractor.

In the tactical rôle it will carry 120 paratroops. For supply-dropping a 25-ton load can be dropped 1,000 miles from base. A typical air-drop would be a 25-pounder gun, its 3-ton truck and 40 soldiers.

As a tactical freighter a load of up to 15 tons can be flown into a rough airstrip 850 miles from the base aerodrome. Loads which could be carried include a complete Twin Pioneer aircraft or five ¼-ton trucks with their trailers and crew.

Four-Jet Powerplant

Four Rolls-Royce Conway 11s of 17,250-lb. thrust have been mentioned as powering the H.P.111. The civil version of this engine delivers 18,500-lb. thrust, however, and no doubt the military transport can make use of this and of more powerful Conway variants as they are developed. Water-methanol injection is used for high-altitude and tropical take-off and short-field operation.

Thrust reversal and silencers are fitted. When reverse thrust is selected the jet efflux discharges forward at 60° to the vertical through apertures in the wing surfaces.

A Blackburn Artouste 510 auxiliary-power unit provides power for all systems and services when the aircraft is on the ground.

Despite the weight penalties imposed by large pressurized loading doors and the strong floor structure, the aircraft has a structure which represents only 27% of its all-up weight.

Fatigue life is based on a combination of the "safe-life" and "fail-safe" philosophies. The recommended safe life is derived from Victor experience; it varies with the aircraft's operational rôle between 45,000 and 18,000 hr. (in the supply-dropping and paratroop rôle).

Fatigue properties of the wing are improved by the large tip tanks, which reduce wing bending stresses; these tanks hold some 25% of the aircraft's fuel.

Many of the airframe systems such as flying controls, stability aids, electrics and fuel pressurization are the same as those of the Victor or developed directly from them. The artificial stability aids in yaw and pitch minimize pilot fatigue during flight at altitude with the autopilot disengaged.

A constant-frequency AC electrical system identical with that of the Victor is used. Power for the flying-control motors is provided in emergency via the auxiliary power unit and by ram-air turbo-alternators.

The Treble One's loading flexibility and its short-field capabilities give it a great potential value as a civil transport. As an airliner it will carry up to 168 passengers.

London to Sydney and New York to London are typical Commonwealth and Atlantic routes on which the Treble One could fly for less than 7¼d. a ton-mile.

There seems no doubt that the H.P.111 would be a valuable addition to Britain's military-transport strength. It would also be of great use to the R.A.F. as a tanker for air-to-air refuelling, besides acting as a transport for all three Services. If Britain's finances in any way permit the ordering of a new military transport—and World conditions certainly show the need for one—there seems to be no doubt that the H.P.111 is a formidable contender.—J.R.C.

John Fricker's Second Report . . . .

(*Continued from page* 251)

C-123 Providers, flown by the team pilot, Lt. Lee Whitehead.

Team results for Event Three were Czechoslovakia, Russia and Bulgaria first, second and third among the men, and Russia, Poland and Bulgaria occupying similar positions for the women.

Event Four, which followed on August 6, was a team spot-landing from 1,500 m., with a delay of 15-23 sec. in free fall. This task was complicated by a steadily freshening wind in the morning, which eventually increased to more than the 6 m./sec. (13 m.p.h.) limit for the women parachutists, but remained just below the 8 m./sec. for the men.

Most coped well, however, and there was some good grouping round the cross, as well as a few landings outside the circle. In the first jump of this event, Mike Reilly had the bad luck to miss the circle, but McLoughlin and Lee achieved 46.5 and 74.9 m. respectively, and Sue Burges managed a creditable 24.24 m. Ala Skopinova, the Russian girl, came nearest of all at 0.63 m.

When jumping started again after lunch the air was beautifully calm. There was so little drift that parachutists were jumping about 5 sec. after crossing the centre instead of the 40-50 during the morning, and spiralling gently down to land all over each other just around the cross. Some very high scores were achieved, the Americans, for example, averaging about 15 m. But by the time the British team was due to jump, at 19.30 hr., dusk was closing in and returning aircraft were using their landing lights, resulting in the cancellation of air sortie.

The Russians, who were last but one to drop, insisted on flying, however, to take advantage of nil wind conditions, and, while their An-2 was climbing through the purpling sky, signal fires were lighted around the target circle to aid the run-in. Their twinkling lights in the deep dusk made an attractive picture, with the parachutes gliding like ghosts silently down in the lifeless air to drop unerringly in the centre of the circle.

Peklin of their team achieved 0.07 m. which must have taken some measuring, and the worst man's distance was 27 m. Following, with their less-manœuvrable flapping skirt parachutes, the Yugoslavs varied between 3.7 and 25 m., although one of their team landed outside the circle.

After two days' rest, the British team completed the second jump of Event Four in a wind which necessitated 40 sec. flying past the cross before exit, and all the men, including the lone Canadian Floyd Martineau, who jumped throughout with us, landed outside the circle. Burgesova did rather better, with a distance of 31.3 m., but jumping was then abandoned because of excessive cloud. After three events the Russians had therefore confirmed their positive lead in both men's and women's teams.

Final contest in the Championships was Event Two, for individual jumps from 1,500 m., with 15-23 sec. stabilized free fall in the direction of the aircraft flight, followed by a spot landing. As the Czechs wished to conclude the competition on this day, a Sunday, for which another air display had been arranged (the opening coincided with Czech Aviation Day), the first teams in this event were forced to begin jumping at 05.00 hrs. in very calm air but with poor visibility.

The British team luxuriously took off at about 08.30 hrs., and we climbed round the foothills of the Carpathians flanking Bratislava, on the winding Danube, for the first jump of the final event. As well as our usual Canadian, we had Lee Whitehead, the American pilot, on board to drop an American parachutist who had missed his own aircraft, and the cosmopolitan nature of the load of the Russian aircraft with a Czech co-pilot was completed by Sue Burges' Czech parachute equipment, which had been sportingly loaned by the Aero Club after her own parachute had been damaged in deployment.

Despite a misinterpretation of hand signals, she did well in this jump, with a stable free fall and a landing within 24 m. of the centre, while Mike Reilly achieved an excellent 6.34 m. Lee and McLoughlin were similarly stable but landed outside the circle. On the final descent, later that morning, only Denis Lee among the British team landed in the circle with a distance of 30 m., and this score was all the more creditable in that a good deal of cloud was encountered during the run-in.

To drop the last man, the American, who was the only contestant still to jump, required another seven or eight attempts, and some 40 min. of manœuvring in and out of cloud.

Event Two was won individually by Dedic of Yugoslavia, with Zujev and Dmitrov of Russia second and third among the men, while Priachinova of Russia was first in the women's contest, with Czech and Bulgarian girls next. Team order was U.S.S.R., Yugoslavia and Bulgaria (men), and Czechoslovakia, Bulgaria and U.S.S.R. (women).

Total points for the complete contest therefore gave Russia a clear victory in both team and individual events, for men and for women, with the Czech and Bulgarian teams second and third among the men, and Poland and Bulgaria in similar positions for the women. Ostrowski of Russia became the new male champion, closely followed by Jehlicka (Czechslovakia) and Milicevic (Yugoslavia), while behind Nadia Priachinova, the Russian woman champion, came Anna Franka (Poland) and Maria Velceva (Bulgaria). The Americans were sixth, and the French eighth, with Rode (France) and Jacques Istel (U.S.A.) gaining the top individual places for the West at 19th and 20th, respectively.

The British men's team had the satisfaction of not being last, being beaten to 12th place by Israel, and individual positions were 52nd (Reilly), 53rd (McLoughlin) and 56th (Lee), out of 59 men contestants. Sue Burges was 19th out of 21 women, but scored more points (760.62) than any of the British men (top score, 640.45).

Private Flying

H.J.C.'s CLUB COMMENTARY

● A "TIPSY WEEK-END" (which, we hope, is not liable to misconstruction) has been planned by the **A.S. Flying Club** at Baginton, Coventry, for September 27-28.

Owners of all the Tipsy monoplanes in the country are being invited, and there will be competitions and formation flying. It is hoped that most visitors will be at Baginton by mid-day on the Saturday, when there will be a buffet lunch, with flying afterwards. Guests are to be accommodated at the Leofric Hotel, in Coventry. Details of fees can be obtained from Miss Ruth Sully, 60 Grangemouth Road, Radford, Coventry.

We can find five Tipsys listed in the current Register—G-AFJR, AFRV, AFSC, AFVN and AFWT, SC being operated by the A.S. club. Mons. E. O. Tips, the Belgian designer of the Tipsy, is being invited to attend in his latest product, the Tipsy Nipper single-seater.

● WHILE the aircraft were temporarily grounded during thunderstorms last week, Mr. Derek (or "Wilbur") Wright, C.F.I. of the **Denham Flying Club,** found time to telephone some news to us.

Although bad weather has restricted flying throughout the year, as at most clubs, hours at Denham have maintained a satisfactory level, and the socal side flourishes.

Plans for the installation of a radio ground station are going ahead, and VHF (123.5 Mc/s) should be available soon.

● THE CLUB is now operating Hawk-Trainers, G-AFBS, AIDF and AJDR —the latter soon to have radio—and an Autocrat; and two Aiglets of the **Airways Aero Club** are based at Denham. Denham pilots have priority on them from Monday to Friday, while the A.A.C. uses them at week-ends. One of them, G-AMTB, is a two-seat touring version, with full instrument panel and suitable for two-stage amber instrument flying, and extra tankage. The other, G-AMTD, is a four-seat aircraft.

● LORD and Lady Douglas of Kirtleside, the Denham club is pleased to report, have accepted honorary membership. Miss Janet Ferguson, until recently assistant instructor, has gained her C.P.L. and recently was co-pilot in ferrying a Dakota from Idlewild, New York, to Tripoli. She will continue instructing at Denham on a part-time basis.

Pilots proposing to land at Denham are reminded that it is necessary to get permission from the club in IMC. This rule has been in force for some time but has not been strictly enforced. Now, at the request of London Airport and R.A.F. Northolt A.T.C., this rule will be rigidly enforced, and pilots should ascertain before leaving their home aerodrome if VMC or IMC prevail over the whole of their route. No special clearance is necessary if VMC is in force; special instructions are needed in IMC. (Denham 2161.)

● LAST WEEK we mentioned briefly the visit paid to the **Surrey Flying Club** at Croydon by air cadets from overseas.

As on the occasion last year when cadets from the Continent visited the Fair Oaks club, this year's contingent showed the greatest keenness and interest in everything they saw. Several club members, including Pete Langstone and Pat Hovenden, acted as hosts, and the cadets were given flights in club aircraft, some of them in the Prentice, G-APIU, which is being operated.

(This Prentice, incidentally, is the only one so far flown by a club; it costs £7 an hour, which may seem high, but Peter Chinn, the C.F.I., tells us that it is being put to good use and pilots feel they are getting their moneys worth.)

● FROM CROYDON, by means of the Surrey club's Leopard Moth, G-AIYS, Pete Langstone driving, we looked in at the **Elstree Flying Club's** tea patrol. As there were no fewer that 15 aircraft defending the aerodrome, it is not surprising that our registration letters were soon taken by a patrolling Autocrat, and then by a Hawk-Trainer, but five of the attacking aircraft managed to get through for free teas.

Visitors who attacked included:—

Hawk, G-AKPL, Moore, Denham; Tiger, G-AOAA, Elton, Croydon; Hawk, G-AKAS, O'Kane, Croydon; Proctor, G-AIEH, Dible, Denham; Auster 3, G-AHLI, Moore, White Waltham; Hornet Moth, G-AESE, Cosmelli, Denham; Tiger, G-AJHS, Bagley, Farnborough; Hawk, G-AIDF, Vaughan, Denham; Hawk, G-AJDR, Arkill, Denham; Chipmunk, G-AOZV, Elliott, Croydon; Gemini, G-AKHC, Pugh, Panshanger; Chipmunk, G-AOJO, Bisley, Croydon; Proctor, G-AHNA, Paine, Fair Oaks; Proctor, G-AOEJ, Clifford, Oxford; Hawk, G-AKAU, Morgan, Oxford; Consul, G-AIAH, Sirett, Croydon; Kitten, G-AEXT, Harrison, Booker; Auster 5, G-AHHS, Williams, Croydon; Aiglet, G-AMTD, Bootle, Denham; Auster, G-AGVJ, Wright, Denham; Leopard Moth, G-AIYS, Langstone, Croydon; Messenger, G-ALAP, Ryder, Staverton; Luton Minor, G-AFIR, Parker, White Waltham; Tiger, G-APIP, Hay, Croydon; Tipsy, G-AFSC, Sibbings, White Waltham; Taylorcraft, G-AHAI, Bennett, Croydon; Autocrat, G-AIRB.

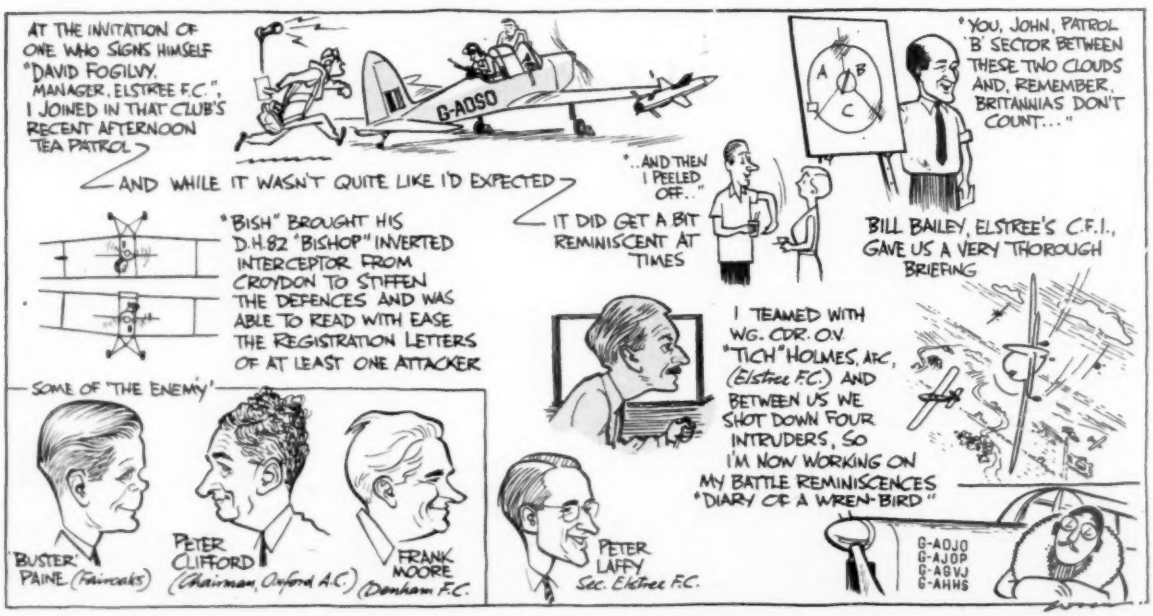
● On the defence were:—

Hawk, G-AKPF, Sebborn; Auster 4, G-AIJM, Moore; Hawk, G-AIUA, Schooling; Hawk, G-AKPG, Craft; Chipmunk, G-AOSY, Cowell; Chipmunk, G-AOSO, Wild; Chipmunk, G-AOSN, Bailey; Tiger, G-APDZ, Bishop; Messenger, G-AKBN, Harrington; Proctor, G-AHGA, Holmes; Auster J.2, G-AJAM, Gutkind; Hawk, G-AHYL, Aarons; Swallow, G-AEMW, Chadwick; Gemini, G-AIIF, Amos, and Auster 4, G-ANHU, Judd.

After the patrol a brief flying display was given, consisting of Messrs. Bailey, Craft and Schooling in three club Chipmunks, and "Bish" in his special Tiger, the last-named becoming airborne in literally the width of the runway! Throughout the afternoon, David Ogilvy, the C.I. (not the C.F.I., as we stated two weeks ago—that is Bill Bailey) gave an exhausting commentary—exhausting for him, that is—not for us!

Elstree is to give another display tomorrow, August 23, starting at 17.30 hrs. and lasting for about an hour and-a-half. Visitors are asked to land by 17.00 hrs. The club, with the **Tiger Club,** will on this occasion, be hosts to a number of French private pilots.

● THIS SHOW is being arranged in the evening to give private pilots a chance of also attending the **Handley Page Power Flying Club's** meeting at Woodley on the same day.


AT THE INVITATION OF ONE WHO SIGNS HIMSELF "DAVID FOGILVY, MANAGER, ELSTREE F.C.", I JOINED IN THAT CLUB'S RECENT AFTERNOON TEA PATROL
G-AOSO
AND WHILE IT WASN'T QUITE LIKE I'D EXPECTED
"...AND THEN I PEELED OFF..."
IT DID GET A BIT REMINISCENT AT TIMES
"YOU, JOHN, PATROL 'B' SECTOR BETWEEN THESE TWO CLOUDS AND, REMEMBER, BRITANNIAS DON'T COUNT..."
A
B
C
BILL BAILEY, ELSTREE'S C.F.I., GAVE US A VERY THOROUGH BRIEFING
"BISH" BROUGHT HIS D.H.82 "BISHOP" INVERTED INTERCEPTOR FROM CROYDON TO STIFFEN THE DEFENCES AND WAS ABLE TO READ WITH EASE THE REGISTRATION LETTERS OF AT LEAST ONE ATTACKER
I TEAMED WITH WG. CDR. O.V. "TICH" HOLMES, AFC, (Elstree F.C.) AND BETWEEN US WE SHOT DOWN FOUR INTRUDERS, SO I'M NOW WORKING ON MY BATTLE REMINISCENCES "DIARY OF A WREN-BIRD"
SOME OF "THE ENEMY"
'BUSTER' PAINE (Faircaks)
PETER CLIFFORD (Chairman, Oxford A.C.)
FRANK MOORE (Denham F.C.)
PETER LAFFY Sec. Elstree F.C.
G-AOJO
G-AJOP
G-AGVJ
G-AHHS

Correspondence

A Sunderland for the Fly-past?

I READ with regret that the Sunderland is at last to retire from the Royal Air Force. When this happens I feel it will be the end of an era in the R.A.F. I very much doubt if any other aircraft will achieve such fame and affection as the Sunderland. Certainly the Shackleton will not. Singapore will never be the same again.

I think I am correct in saying THE AEROPLANE has always had a soft-spot for the flying-boat.

What I have in mind is that you use your influence with people in high places to preserve a Sunderland for any future R.A.F. museum. One could be flown home from Singapore. It could then take part in the "Battle of Britain" fly-past in September before going into retirement at R.A.F. Felixstowe or Pembroke Dock.

Chippenham, Wilts. "CONTROLLER."

R.34 Memorial

ON behalf of those who were engaged in Lighter-than-Air activities, may I express thanks for giving so much space in protest against the proposed "Work of Art" to commemorate the Atlantic crossing of the R.34.

Not only is it revolting to look at, but it does not appear to have the slightest association with airships, and I trust those who subscribed will ask for their money back.

Surely this is a further example of the arty-crafty approach whereby so-called works of art are imposed upon the public, and the sponsors get away with it, because the majority of people do not bother to protest.

J. FAIRLEY
(Hon. Sec., Lighter-than-Air Dinner Association).

Kimpton, Herts.

Powered Hops of Pioneer Aircraft*

The Establishment flies,
Hoppity, hoppity,
Hoppity, hoppity, hop,
Whenever it's said
Cody's up in the skies!
(And won't he 'arf cop it)
If ever he tries
To make it a hop!
Performance big wigs,
As merry as griggs
Will prove he can't hop it,
However he tries.
BUT can't we all stop it,
And from the scene drop it
And hoppity hop it,
Hoppity, HOPPITY, HOP?

Preston Park, Sussex. J. LAURENCE PRITCHARD.

*THE AEROPLANE, July 25, 1958.

Importance of L.C.N.

THE continuing increase in the weights of new aircraft types adds importance to the question of whether the bearing strength of a particular runway is sufficient for a certain type of aircraft.

Your survey of commercial aircraft in the issue of July 4 will be kept by many for reference and it is a pity that Load Classification Number is not included in your selection of "vital statistics."

If the information is available perhaps you could supplement the survey with the Tyre Pressure and Wheel Arrangement of each type reviewed, thus giving the means of calculating the L.C.N. at any weight.

Lisburn, N.I. W. J. EAMES.

Aliens in Transit—A Legal Ruling

IN your issue of August 1 Mr. Laurence Webley stated at the end of a very interesting and informative article that the court's interpretation of the Aliens' Order, 1953, should prevent such a difficulty arising again either at London or elsewhere in this country.

I wonder if it is safe to hope that such a difficulty would not arise again elsewhere in the country? Where the distance between the immigration hall at London Airport North and the immigration hall at London Airport Central is only about a mile, and where there is plenty of transport and there are perhaps enough immigration officials to escort a passenger between one hall and another, there should not be any difficulty in implementing the court's decision.

But suppose an aircraft bound for London Airport diverts to Gatwick? How is the alien to be transported to the former place to make his connection? London Airport might in any case be closed by fog for two days.

The immigration officials can always deal with this by refusing permission to land, and requiring the alien to fly out from the airport on the next available service. This could put the operator in an embarrassing position, as he might be unable to recover the cost of the return ticket from the passenger.

It is a problem which is unlikely to arise often, but I would suggest that the last paragraph of the article could lead airline operators into thinking that they will never have to face the problem.

Rome, Italy. C. B. H. BARFORD.

Aroundabout

Technical Dept. Returning from a flight, a fighter pilot entered on the aircraft's Form 700: "Something loose in the tail." Next morning, when he was handed the form for pre-flight initialling, he found the following reassuring note: "Something loose in tail tightened."

*

Natural Error. Confirmation of a Scottish Aviation claim appears in *Petroleum*, which reports that Fison-Airwork, Ltd., who operate a Whirlwind fleet in the Niger Delta for the Shell-B.P. Development Co., have ordered two Twin Pioneer helicopters.

*

There was once a well-known racing pilot who took off with his brakes on, then complained that the airfield grass was too long.

*

Afrontery and Caboshment. If you splendid readers should ever withdraw your generous support of this column, I could always get a bit of help from the College of Heralds' descriptions of R.A.F. badges. Some of the latest contain such neatly turned phrases as: "A hind's head and neck afrontee and erased," "A pointer dog statant," "A four-leaved clover slipped enfiled" and, best of all, "in front of a Viking Shield a bull's head caboshed." Speaking of the Vikings, did you know that their initial successes against the Saxons are attributed to the cows' horns they wore on their helmets? We didn't know whether to fight 'em or milk 'em.

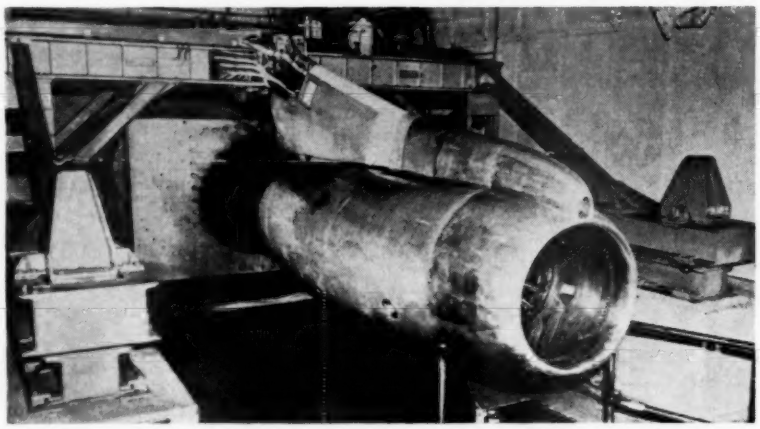
*

*

Starting at the Bottom. Scene: A conference between airliner makers and customer to decide furnishing standards. The colours of the roof cloth have been debated and settled; the materials of the side walls have been handled, smelt, looked at in various lights, burned with cigarettes and finally selected; samples of carpet have been similarly debated and now it's the chairs. "Would you like to have your seats covered with this—or this—or perhaps—this?" President of airline, wearily: "Look, if I can see all my seats covered with backsides I'll be happy."

by Gremlin

NOTES AND EVENTS



REPRESENTED AT FARNBOROUGH.—This special thrust cradle has been built by Heenan and Froude, Ltd., to accommodate the Rolls-Royce Conway by-pass engine in the podded form in which it will be supplied to the Boeing Airplane Co. For test the engine is cantilevered out from the cradle so that conditions closely resembling those of flight can be simulated.

SERVO VALVES.—Dowty Equipment, Ltd., has completed a licensing agreement with the Moog Valve Co., Inc., of East Aurora, New York, for the manufacture of Moog servo valves in the U.K. The agreement covers the U.K., British Commonwealth (excluding Canada) and Europe (excluding Iron Curtain countries). The valves are four-way units in which the hydraulic output is proportional to the electric input.

ENGINEERING COURSE. — The Kingston Technical College has just issued a booklet giving details of a course in aeronautical engineering. The next session opens on September 22, and those interested should communicate with the Principal, Dr. J. R. I. Hepburn, at Fassett Road, Kingston - on - Thames, Surrey.

HARVEY SERVOS.—Harvey Electronics, Ltd., has formed a new subsidiary, Servo Units, Ltd., at 273 Farnborough Road, Farnborough, Hants, to handle all the company's servo mechanism work. Servo Units' first new products will be a series of fully transistorized power servos.

WIGGIN EXHIBITIONS. — Henry Wiggin and Co., Ltd., is staging a series of four-day exhibitions devoted to the practical uses of nickel and its alloys at Newcastle, Leeds and Belfast during September and October. The first will be at the Royal Station Hotel, Newcastle upon Tyne (September 23-26); the second at the Metropole, Leeds (October 14-17) and the third (October 28-31) at the Grand Central Hotel, Belfast. With each exhibition will be a series of lectures and film shows on the practical uses of Wiggin alloys in high-temperature work and in chemical and electrical engineering; others will feature welding techniques.

FUEL MONITOR.—Designed by the Shell Petroleum Co., in conjunction with Stream-Line Filters, Ltd., is a new device known as the Fuel Monitor for augmenting the present precautions taken to prevent risk of contaminated fuel being fed into aircraft. It comprises a valve and sensitive element inserted in the main fuel stream to the aircraft. If contaminated fuel passes through the sensitive element the main valve closes. In normal operations the valve will open and close with the delivery valve and any risk of it becoming "frozen" in the open position is eliminated.

EARLS COURT SHOW. — The annual National Radio and Television Exhibition will be held in London from August 27 to September 6. Among the exhibits will be equipment displayed by the R.A.F. and Royal Navy illustrating their dependence on electronics; a model of the Jodrell Bank radio telescope will be the central feature of the Radio Industry Council stand.

D.F.S. PUBLICATION.—A leaflet giving details of the D.F.S. metal shrinking and stretching machine has been published by the sole distributors, Robert Kelly and Sons, Ltd., of 55 Market Street, Manchester, 1.

MISSILE UP-LIFT.—Short Bros. and Harland, Ltd., has acquired the British Straddle Carrier Co., Ltd., and will produce the new Mk. 2 vehicle. This straddles the load, which is mechanically lifted and clamped below the superstructure. The vehicle has a 20,000-lb. capacity and is seen here carrying a Short G.P.V.

Aviation Calendar

August 23.—Air Display organized by Elstree Flying Club in conjunction with the Tiger Club at **Elstree Aerodrome**, at 17.30 hrs.

August 23.—Tea Patrol and Air Display organized by the Handley Page Power Flying Club at **Woodley Aerodrome**, Reading.

August 24.—Luton Flying Club Air Display at **Luton Airport.**

August 25-30.—Ninth International Congress on Astronautics at **Amsterdam**, Holland.

August 31.—Oxford Aeroplane Club "At Home," at **Kidlington Airport**, Oxford.

September 1. — S.L.A.E. main lecture "The Engineering Development of Turbine Aircraft as Influenced by World Traffic Patterns," by D. J. Lambert, A.M.I.Mech.E., A.F.R.Ae.S., assistant general manager, development, Vickers-Armstrongs (Aircraft), Ltd., in the main assembly hall, R.A.E., **Farnborough**, Hants, at 18.30 hrs.

September 1-7.—S.B.A.C. Display and Exhibition, at **Farnborough.**

September 4.—Helic. Assn. of G.B. annual dinner at the Dorchester Hotel, Park Lane, **London**, W.1.

September 4-6.—AGARD Avionics Panel Meeting at **Cambridge University.**

September 8-13. — First International Congress of the Aeronautical Sciences, **Madrid.**

September 12-22. — Aeronautical Pentathlon and Air Rally at **Liège**, Belgium.

September 15-21. — Battle of Britain Week.

September 20. — Aviation Forum of London, annual dinner, at the Aerodrome Hotel, **Croydon**, Surrey.

September 21.—Sailplane aerobatic competition organized by the London Gliding Club, at **Dunstable**, Beds.

September 21.—Air Rally organized by the Milan Aero Club, at **Milan.**

September 21.—Royal Belgian Aero Club international concourse for balloons, **Brussels.**

September 25.—R.Ae.S Graduates and Students Section lecture, "The Next Generation of Civil Aircraft," by G. H. Lee (Handley Page, Ltd.), in the Library, 4 Hamilton Place, **London**, W.1, at 19.30 hrs.

September 26-29.—Austrian Aero Club Rally at **Innsbruck.**

September 27-28.—"Tipsy Week-end" organized by the A.S. Flying Club, at Baginton Airport, **Coventry.**

October 4.—Aviation Forum of London lecture, "The Channel Air Bridge," by Douglas Whybrow, at the Imperial Hotel, Elizabeth Street, Victoria, **London**, S.W.1, at 19.00 hrs.

MILD-STEEL ELECTRODE.—A new iron powder electrode called Ferrolux has been produced by Quasi-Arc, Ltd., for the welding of mild steel. It is intended for high-speed welding in the flat and horizontal-vertical positions, and using a touch-welding technique the electrode can be drawn out to make long smooth fillet welds.

Company Notices

NEW COMPANY

Wynn Developments, Ltd. (608,757).—Private co. Reg. July 28. Cap. £2,000 in 40,000 shs. of 1s. Objects: To carry on the business of research engineers in the design and improvement of all types of electronic equipment, instruments, apparatus, devices and appliances used in connection with the manufacture and operation of aircraft, engines, motor vehicles, ships and all mechanical equipment and vehicles, etc. Directors: Edward D. Wynn, Beechurst, The Reddings, nr. Cheltenham, director of E. Wynn and Co. (Aircraft), Ltd., etc.; Hubert Broad, 11 Lochmore House, Ebury Square, London, S.W.1, director of Aircraft and Automobile Services, Ltd., etc.; Richard W. Lambeth, Ellingham House, Pittville Lawn, Cheltenham, director of Aerocraft, Ltd., etc. Sec.: R. H. Smith. Reg. Off.: Alma House, Rodney Rd., Cheltenham.

New Patents

APPLICATIONS ACCEPTED

802,280.—United Aircraft Corporation.—"Convertiplane."—Jan. 4, 1956 (Jan. 5, 1955).

802,157.—Warnken, E. P.—"Blades of air-foil configuration and the method of making same."—April 16, 1955.

802,123.—Rolls-Royce, Ltd.—"Jet nozzle arrangement for jet-reaction-propulsion purposes."—Feb. 19, 1957 (Feb. 27, 1956).

Applications open to public inspection on Oct. 1, 1958; opposition period expires on Jan. 1, 1959.